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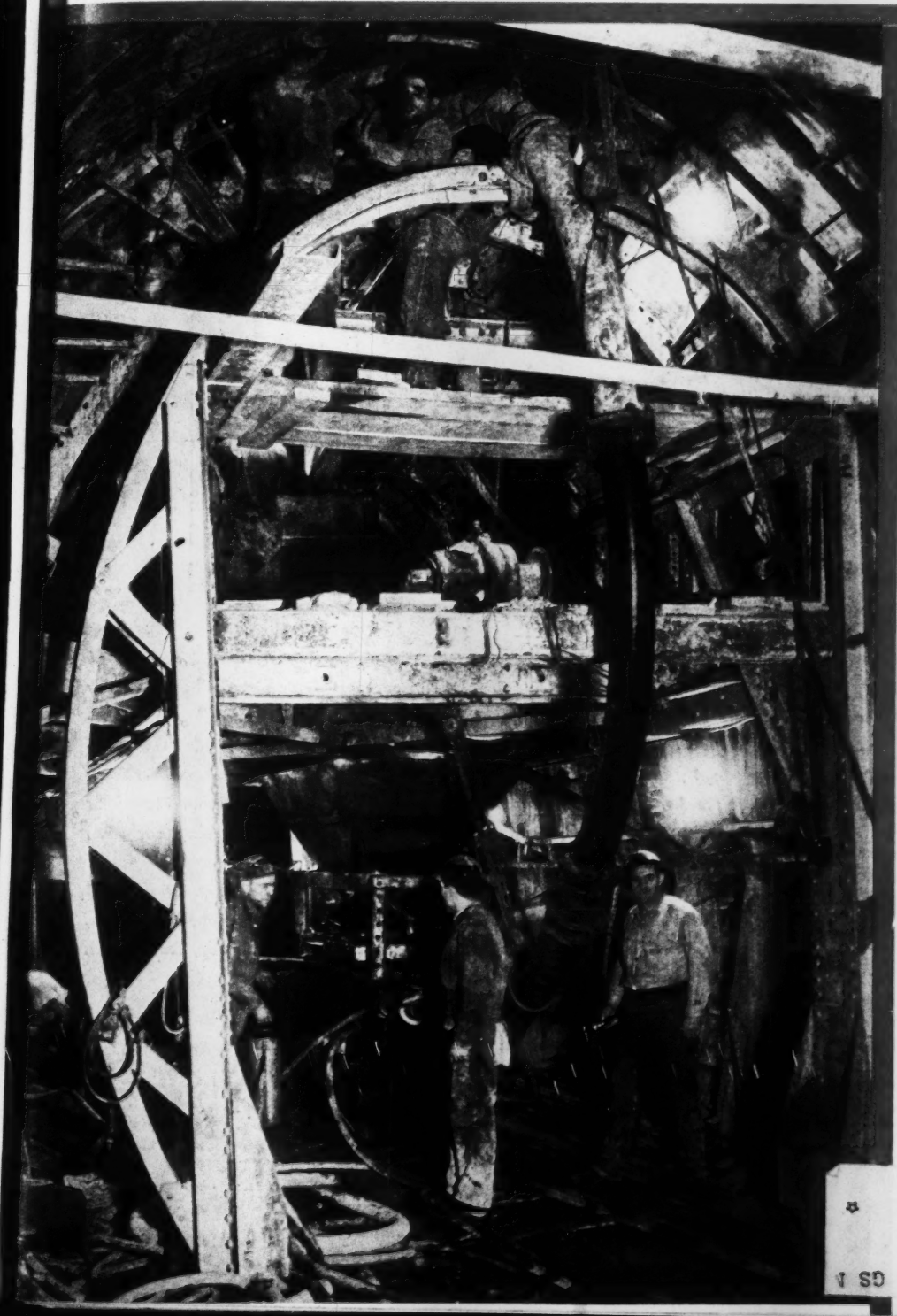

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CONCRETING THE ARCH of the Southwest intercepting sewer tunnel in Chicago using pneumatic equipment. The discharge pipe is carried by the form-moving gantry

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Much more information in the nature of engineering data and records of recent installation is available. Ask any Byers Engineer or write our Engineering Service Department for the engineering report on "The Use of Wrought Iron in Sewage Treatment Plants" or for assistance in analyzing corrosive conditions.

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A MOMENT WITH THE PUBLISHERS

Technology Forges a NEW TOOL

THE establishment of a new type of industrial research foundation at Wisconsin and Purdue and now at the Ohio State University carries a significance far beyond that of its immediate value to the cooperating industries and universities.

These foundations may well mark a turning point in the relationship between organized learning and practical industry. They certainly should go far toward bridging the gap that too often sets off the workers in pure science from the industrialists who alone can make their efforts useful; they may help to disarm one of the major criticisms of the existing economic order.

For centuries the universities have been trustees for the accumulated knowledge of mankind. First, it was religious and cultural learning alone; then came the amazing flood of scientific knowledge. In all these fields progress has been nourished by the universities, relatively sheltered from the vicissitudes of the economic world about them.

But if the discoveries of science are to benefit humanity they must be applied practically through the mechanism of industry, business and trade. At first, such application was wholly a matter of individual initiative and enterprise. The industrialist might or might not put to effective use what science had made available. Always sensitive, in his competitive world, to the conflict between immediate outlay and return, he might well dismiss such effort as of negligible practical value to him.

THEN came the corporation with its larger aggregations of capital and those more far-sighted industrial executives who were required to conserve that capital. They brought to industry a new appreciation of industrial research. Some of the greater industries, either as units or groups, reflect that appreciation. Some of the universities, within their prescribed powers, have cooperated admirably with them. Real progress has been made and will continue.

But despite all that, such efforts will rest on a precarious footing so long as their continuity must be subject to the vicissitudes of the business enterprise. We have yet to iron out the defects of our economic system to a degree where industrial enterprise can count on the stability required for consistent progress in technical research. And if society is to benefit fully by the march of science, that stability must somehow be realized.

Cooperative effort between industry and the universities, whereby we combine the aggressive and practical attack of competitive industry with the scientific resources and stability of the technical faculty, can help substantially to free industrial research from the hazards of industrial enterprise and to extend to it some measure of the security that has sheltered the pure sciences. And, in doing that, we help to answer those critics who contend that society as a whole cannot profit adequately from our scientific progress until we divorce its application from the vagaries and exploitation of private enterprise.

The experience of the Purdue foundation has shown that such a conception is no mere theoretical ideal; in some instances it has been a most practical reality. And what has been accomplished in a few cases can, through a sufficiently competent and comprehensive extension of this effort, be made typical of all industrial technology.

BUT if this new agency of industrial research is to achieve in proportion to its opportunities, neither the industries nor the universities can approach it in any spirit of immediate special interest on the one hand or of academic disregard of industrial incentives and viewpoints on the other. The industrialist must think of the long-term interests and stability of his house and his industry rather than of his current profits alone; the professor, in the selection and development of his projects, must contemplate the limitations that govern the industrialist.

With such a mutual understanding and cooperation the new research foundations may well become a substantial contribution toward the pressing problem of adapting more perfectly our scientific progress to the social welfare of all the people.

Willard Chevalier

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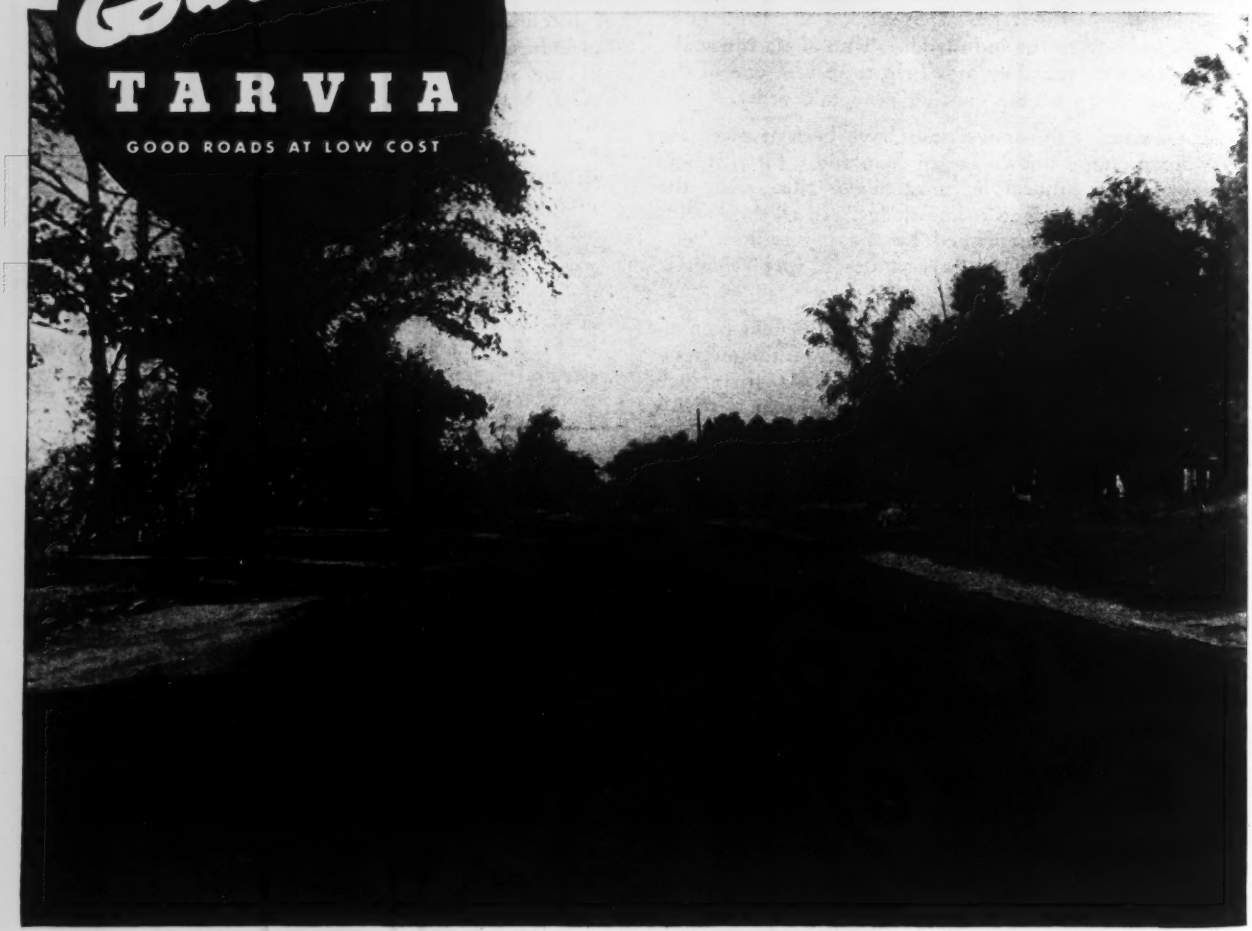
GOOD ROADS AT LOW COST



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Editorial Staff
V. T. Boughton
W. G. Bowman

Chicago
W. W. De Berard

F. E. Schmitt, *Editor* Willard Chevalier, *Vice-President*

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E. J. Cleary

San Francisco
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Silicosis? To most engineers and contractors silicosis is one big question mark. What is it? What causes it? How does it affect construction operations? How can it be prevented? What is the status and trend of legislative and compensation measures regarding silicosis? The answers to these and other important questions on the subject will be answered in a series of articles starting next week—"Control of Rock Dust in Construction."

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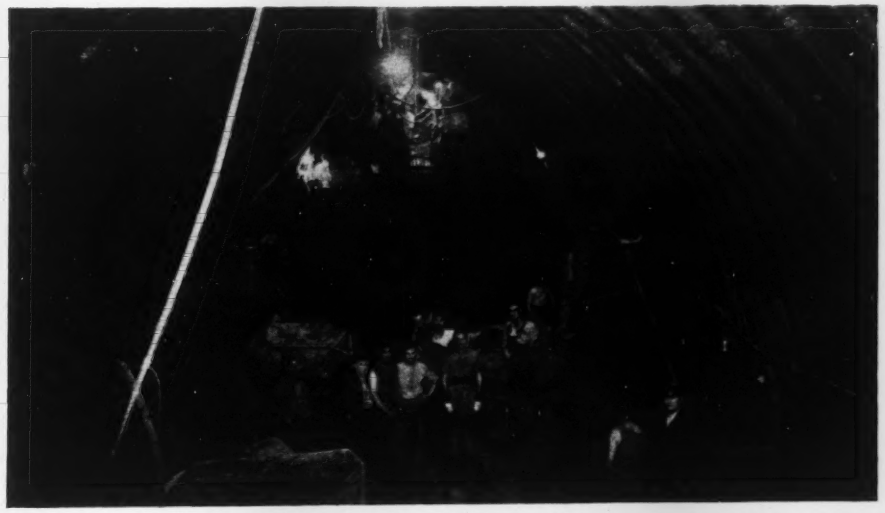


FIG. 1—DRIVING the last link in Chicago's network of intercepting sewer tunnels. This is a 19-ft. section of the Southwest interceptor. The ground is supported by steel plates and ribs, carried on steel posts.

Chicago's Sewer Tunnels

Southwest interceptor is last of major items necessary to complete extensive sewage disposal works that will permit reduction of lake diversion—Tunnel driving methods vary from soft-ground work on previous projects

CONSTRUCTION of the $58,630,000 sewage disposal works being built for the Sanitary District of Chicago under a loan and grant agreement with the Public Works Administration is progressing at such a rate that the district will be able to accept the reduction in diluting water from Lake Michigan on Jan. 1, 1939, as ordered by the U. S. Supreme Court, without endangering the water supply of the Chicago metropolitan area. Principal items in this program are the Southwest sewage treatment works and the Southwest intercepting sewer leading thereto, both of which are now under construction.

The Southwest project is the last of the four major divisions of the treatment program of the sanitary district to be placed under construction. Upon its completion the entire 442 sq. mi. of the district will be provided with treatment plant facilities. Additional intercepting sewers and plant extensions requiring about $44,000,000 may be needed in future years to complete all the details of the treatment program. Cost of the entire treatment program is estimated to be $202,357,000. Total daily pumpage of sewage upon completion of the work now in progress will average 1,326,000,000 gal. Treated effluent from all of the treatment works will flow through the Chicago Sanitary and Ship Canal to the Illinois River and thence to the Mississippi.

Southwest interceptor

The Southwest intercepting sewer will be 12.4 mi. long, lying along the south and east banks of the Sanitary and Ship Canal and the south branch of the Chicago River from the treatment works in Stickney to Taylor St. It will receive all the drainage from an area of 68 sq. mi., having a present population of 1,200,000, and including the stock yards, which produce industrial sewage equivalent to another million population. The area served extends from the canal and river to 87th St., Harlem Ave. and Lake Michigan. The present interceptors along the lake front and all city sewers which now empty into the river from the south side will be connected into the new intercepting sewer. Average dry weather flow in 1940 is expected to be 384 m.g.d with storm maxima of 613 m.g.d. The sewer was designed with capacity for normal population increase up to 1980, taking into account the fact that there will probably be some decrease in the per-capita consumption of water with the introduction of universal metering by the city of Chicago.

The intercepting sewer is in ten sections as shown in the accompanying table. Collateral work and connections will be covered by three additional contracts. Typical sewer tunnel cross-sections are shown in Fig. 4.

Ground conditions encountered in the first 5 mi. of the western half of the sewer were favorable for machine mining. Needle beam and radial shoring as used in the soft blue clay of previous projects were not required. Their use was described in *ENR* June 13, 20 and 27, 1935, covering driving of the West Side sewer tunnels. For the most part the tunnel has been driven through hardpan and rock. Very little water has been encountered to date, and it has not been necessary to put the work under compressed air. Test pits along the route of the remaining sections indicate that a wide variety of soil conditions ranging from rock to soft clay and running sand may be encountered.

Conditions in the first five sections

FIG. 2—ROCK section of 18-ft. sewer tunnel (above) where steel ribs for roof support are carried on dowels drilled into the walls. At the left is a concreted section; the forms are simple plates and ribs, moved and set by a traveling frame fitted with jacks.

have been identical. In each case hardpan and the Niagara limestone bed rock have been encountered. The tunnel crosses through the top of a shallow sub-surface ridge of rock nearly 2 mi. wide; in this a full rock face was encountered for only a few hundred feet, the remainder being part rock with clay and hardpan above. The clay in most cases was so hard it could not be excavated by a power shovel until after being loosened by blasting or by pneumatic spades. Although hard, it required continuous roof support and some cross bracing to prevent lateral movement. The rock was a fairly uniform limestone, unstratified and of medium hardness.

Tunneling procedure

Tunneling in general followed the heading and bench method. Mining the top heading was done entirely by pneumatic spades, the miners casting the muck down off the bench to be loaded into dump cars by power shovel. The top heading was made only large enough to give the men room to work and set up a temporary support of steel liner plates and steel ribs extending between springlines of the arched roof. Some variation occurred on Contracts 2 and 4 where a small drift or monkey hole at the springline on each side was driven ahead of the heading far enough to receive a length of 8-in., 31-lb., H-beam to be used as a sill to support the ribs for the arch lining. The ribs and plates of the temporary lining were placed as fast as the top heading progressed, with the ribs resting on the sill or on maple-heart blocks at the springline. The steel sill was supported on 5-in. H-section legs reaching to the bottom of the side wall (Fig. 1). Mining of the bench was mostly done by power shovels after the clay had been loosened by blasting and large chunks split by air spades.

Mining in the rock sections was by the standard heading and bench method except for 3,500 ft. of Contract 3 where a 9x10-ft. pilot hole was driven from a second shaft and then enlarged to full section by jackhammer drilling and blasting. No timbering was used in the pilot tunnel, and temporary roof support in the enlarged section was provided by steel arch ribs and liner plates resting on dowel pins drilled 2 ft. into the rock side walls (Fig. 2). The amount of blasting varied, depending upon the hardness of the ground and the amount of rock in the face. Only enough dynamite was used in the clay to break it into large chunks which could be split by air spade or concrete breaker into sizes to be handled by the muck shovels. A typical round in the hardpan consisted of six 16-ft. holes with 72 sticks of dynamite and two delay exploders.

The amount of rock varied from none to a full rock face. Blasting in rock varied with the height of rock in the face. From eight to twelve holes ten feet long were loaded with 50 to 175 lb. of 60 per cent dynamite and fired by delay exploders. These shots were all lifters placed after the top heading had been mined and the ceiling supported.

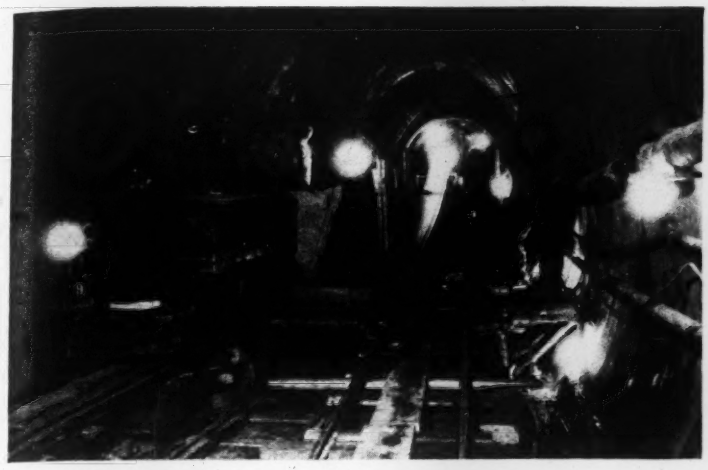
Mucking procedure and equipment were similar in all sections. On all but Contract 1 air or electric power shovels of 3/8 or 1/2-yd. capacity were used to load muck into 1-yd. dump cars on 24-in. tracks leading to the main shaft. Hand loading has been used only in the double barrel section on Contract 1. A single track was laid through each form, branching into two stubs at the loader. Empty cars were pushed by hand to either of these stubs. Loaded cars were pulled about 200 ft. back from the loader by cable from an air hoist and coupled into trains to be pulled to the shaft. Each main shaft was fitted with a double-cage hoist which lifted loaded cars to a steel trestle extending over a driveway where the cars were dumped directly into trucks which hauled the spoil to disposal points. All haulage was by electric storage battery mine locomotives, the maximum haul being 5,100 ft.

Concrete lining

Thickness of concrete lining in earth sections averages 18 per cent of finished width at springlines and 9 per cent of finished inside height at the key. No vitrified or other type of inner lining is provided, and density of concrete is relied upon to make the structure tight.

Except in the full rock section the concrete lining is heavily reinforced in both directions, the amount of steel depending upon soil and loading conditions encountered. Increased strength was secured where necessary by adding reinforcing steel. Steel for the invert was placed on precast concrete blocks and wired to rods projecting from the previously finished section. Steel for sides and arch was wired to the bottom steel and to the temporary lining where necessary.

Concrete in the invert was placed rather dry and tamped by hand. The walls and arch were vibrated with external vibrators as the forms were being filled. Concrete was poured in a length of the invert and allowed to harden one day before the forms for the walls and arch were moved forward. Planks were laid on top of the invert and the putlocks or cross timbers for support of



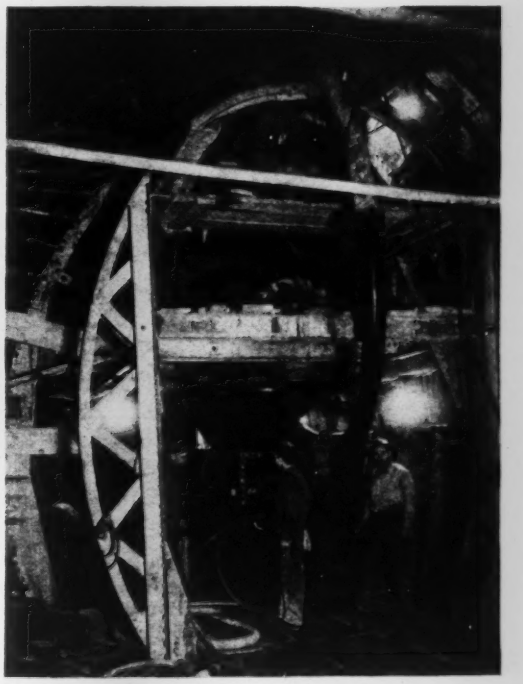


FIG. 3—PNEUMATIC placers for the arch sections of the concrete lining. Concrete trains, loaded from pipes leading from the surface, dump the mix onto a belt conveyor (above) that feed the charging hopper of the gun. At the right is a view of the gun and carriage.

the working floor placed thereon and carefully checked for line and grade.

Steel rails were then laid on the putlocks to carry a traveling frame or jumbo to support the forms for the concrete lining. The forms were made of steel-plate sections about 3 ft. square, bolted or clamped together and supported by a subframe shaped to hold the form sections to the desired curve of the finished lining. Bottoms of the forms were wedged against the ends of the putlocks to prevent the form from kicking in. The end of a section to be concreted was closed by a steel bulkhead made in 3-ft. sections held against the end of the form by bolted clips and by blocking against the temporary steel liner ribs.

Concrete for Contract 1 was secured at the central mixing plant for the Southwest disposal plant, hauled to the tunnel line in trucks and dropped to the invert level through pipes in well drill holes. On the other four sections, mixers were placed just below ground level at the shafts, permitting gravity charging of aggregates. Materials were delivered by barge to Contract 2, within reach of cranes that charged bins over the mixers. Commercial material yards furnished batched aggregates for the remaining three contracts. The shaft mixers discharged directly into pipes leading to the tunnels.

Concrete specifications

Concrete was manufactured under rigid specifications which prescribe water-cement ratio, gradation of aggregates, mortar strength, compressive strength, mixing, placing, and finishing. The mix specified was 1:3:4 with provision to vary the proportions as needed to secure the desired workability and still maintain the specified strength of 2,400 lb. at 7 days and 3,000 lb. at 28 days. No waterproofing or other admixtures were used. The concrete was vibrated with both internal and external vibrators to compact it thoroughly into the forms and bring enough mortar to the surface to produce a smooth finish. Test cylinders made every week show that the 7-day compressive strength averaged more than 3,000 lb. (2400 specified), and 28-day strength exceeded 4,000 lb. where 3,000 lb. was specified.

Concrete handling

Concrete handling methods and equipment on Contracts 2 to 5 were identical. In each case the 1-yd. mixers discharged through a pipe into 1 yd. dump cars on the tunnel floor. Trains of dump cars were pulled to the heading on double-track railway and dumped onto an inclined belt conveyor extending over the platform near the top of the form jumbo. Enough concrete to fill the forms 18 in. above the springline was chuted through openings in the form. Then the openings were closed and the arch concreted with a pneumatic placer which discharged through a curved pipe entering the forward bulkhead at the key (Fig. 3). The placer thus delivered a stream of concrete at high velocity against the end of the previous day's concrete. Air pressures up to 120 lb. were used, which packed the concrete tightly into the form. The pneumatic placers handled the concrete at a rate of 3 cu. yd. per min. and eliminated the usual troublesome key plates and manual handling for filling the key.

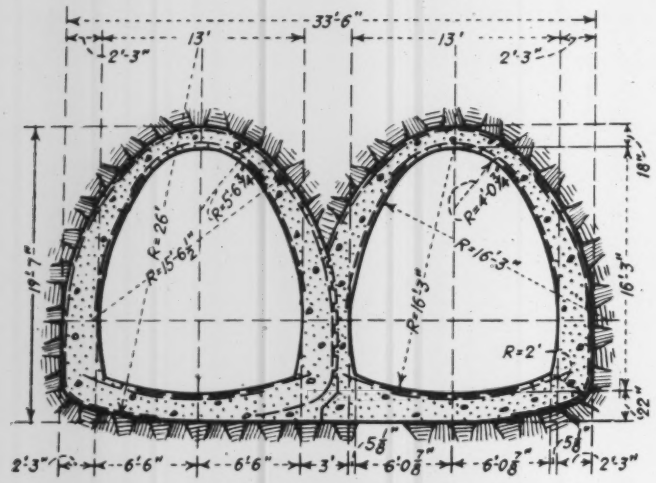
Grout nipples 1½ in. in diameter extending through the concrete and the temporary steel lining were placed 8 ft. apart near the crown of the arch. After the concrete had set, a 1:3 grout was forced through these nipples under pressure to fill all voids and to avoid any settlement in the street. Construction joints were grouted with a 1:1 mix or with neat cement if necessary to stop leaks.

Concrete was placed in the invert to within 1½ in. of grade and timbers for a working floor were then placed. The last operation as the contractor retreated out of a heading was to take up the construction floor and tracks, carefully clean off the rough concrete of the invert and apply a 1½-in. topping of rich concrete of ¾-in. aggregate, carefully screeded to exact shape and float finished.

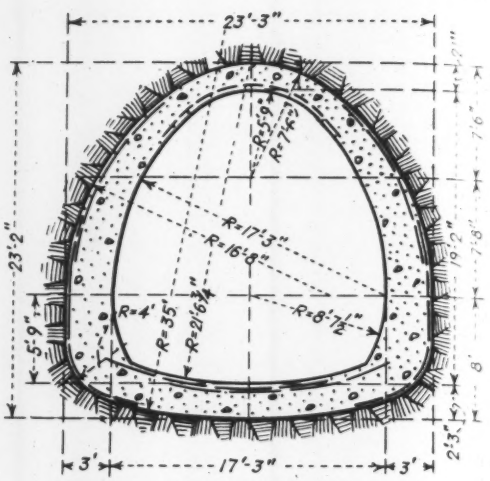
Concreting in compressed air

Conditions encountered since writing the above have required changes in some operations on Contract 5. It has been necessary to place that section under compressed air. Also, the smaller space available in the 9-ft. tunnel has made it difficult to use machine muckers to advantage except for loading large rock.

In order to eliminate the delay of handling trains of concrete cars through an air lock at the main shaft the contractor has developed a system whereby the concrete is delivered through a vertical air lock direct from the street into the hopper of a pneumatic placer for blowing into the forms. A mixing plant has been set up in a nearby yard of the material supply firm which delivers materials into his bins by crane and bucket. Mixed concrete, using heated aggregates when necessary, is discharged into 2-yd. dump trucks fitted with oil-burner heaters. The trucks are driven to the receiving hopper of the air



Section of 2-Barrel 13'-0 X 16'-3" Sewer Tunnel



Section of 17'-3" X 19'-2" Sewer Tunnel

FIG. 4—TYPICAL SECTIONS of the larger sewer tunnels. Smaller tunnels are of the same general shape, a double ellipse.

lock where the concrete is dumped through a 10-in. pipe direct into the gun which forces it into the steel forms by compressed air. With this system the concrete is delivered into the forms in less than 5 min. after it leaves the mixer and the average time to concrete a 24-ft. length of tunnel is less than 1½ hr.

The vertical lock for concrete consists of a 10-in. pipe with circular hopper and air-tight gate at the top and an air-tight control gate at the bottom. A 2-in. pipe carries compressed air from the tunnel to the hopper to relieve the suction caused by the concrete traveling down through the main pipe. Communication by bell signals and telephone makes it possible to coordinate operations above and below ground so there is no lost time. The concrete lock is moved forward every 200 ft. so the length of pipe from blower to form never exceeds 250 ft. The blower is used for placing all of the concrete for sides and arch and the concrete for the invert is handled from the lock in dump cars and tamped by hand.

Hand labor judiciously used

Conforming to P.W.A. regulations, manual labor has been employed to the maximum extent consistent with good engineering practice and economy. Nevertheless, it has been necessary to make extensive use of power tools and equipment. All of the earth excavation has been in material so hard that pneumatic spades and concrete breakers were required to loosen it. Rock drilling was done by the usual methods using jackhammers and drifters. Muck was loaded by air-operated or electric power shovels of ⅜ or ½-yd. capacity mounted on crawlers. Concrete for sides and arch was placed in the forms by high-pressure pneumatic placers which were charged by inclined belt conveyor. Pneumatic vibrators have been used throughout and single-drum air hoists or tuggers were used for a variety of purposes. One hoist mounted on the platform of the form carrier was used to move the carrier forward and for miscellaneous operations in the heading. Another air hoist mounted on a car truck with rail clamps was used back of the forms for pulling loaded muck cars away from the heading face, for handling concrete cars, shifting track sections, moving machinery and miscellaneous pulling and hoisting requirements. Such pumping as was necessary was easily taken care of by small air or electric pumps. Ground water that accumulated in the invert prior to concreting was removed by a small portable centrifugal pump driven by pneumatic motor.

Safety regulations

Each shaft was equipped with a double-cage, mine-type hoist with covered steel cages fitted to steel guides and provided with all recognized safety devices including landing dogs, overwinding and down-speed regulators. Individual signal systems, so arranged that the actual signal for hoisting was given by the man stationed at the bottom of the shaft, were installed for each hoist. All haulage of muck and concrete in tunnel was by electric mine locomotives driven by storage batteries with removable battery boxes. At each shaft there was a complete charging plant with two motor-generators and enough spare sets of batteries to insure an ample supply of fully charged batteries at all times. Steel cars of 1-yd. capacity operating on 24-in. tracks were used for all hauling.

Uniform safety regulations were enforced throughout. They required that a certified safety engineer be employed on each contract. At the top of each shaft was a set of five, 2-hour gas masks with spare oxygen tanks, flashlight and tools ready for immediate use. Training in mine rescue work was given to selected squads of at least seven men on each shift for a minimum of one hour each week. Enough self-rescuers to equip every man employed were kept within 200 ft. of each heading at all times and all employees were given weekly instruction in their use. Equipment for detection of dangerous gases was provided at each shaft and routine tests for gas were made on each shift. Only fireproof materials were allowed in construction of shafts and top plant. Miners' safety lamps were kept burning in the headings at all times and adequate fire extinguishers and fire hose were always ready for use.

Details

Contract 1 differs from the others in that it is a double-barrel tunnel, each barrel being 13x16 ft. No rock was encountered in this section, and muck was loaded by hand. Each barrel was built as a complete structural unit and the two were joined by a keyed construction joint. Construction of the first barrel was maintained about 200 ft. ahead of the second.

Concrete discharge pipes were spaced 250 ft. apart on the centerline of each barrel and had a 3-yd. receiving hopper with gate at ground level. Concrete for the invert was discharged into dump cars on the track on the construction floor and moved to the heading and dumped directly into the invert where it was tamped by hand. Concrete for the sides and arch was handled by a traveling carrier which also served as a means for moving the steel forms. The carrier had two hoppers, each holding 3 cu. yd., and was fitted with flanged wheels so it could be moved

under the delivery pipe (Fig. 5). The two hoppers were filled with concrete and then the carrier was moved into position over the pneumatic placer at the form and the concrete fed into the 3-yd. hopper of the placing machine which forced it into the form in lots of $\frac{5}{8}$ of a yard per shot. A portable mixer with platform scales for batching aggregates was moved over each delivery pipe to mix the concrete for the special topping of the invert. The mixer discharged directly through the delivery pipe into dump cars on a temporary track laid on the rough concrete after the working floor had been taken out.

This contract also includes a screen chamber 59½x76 ft. in plan and 62 ft. high, six barrels 10x12½ ft. between the screen chamber and pump house 348 feet westward, 10x12½-ft. branch sewer 197 ft. long, a 4x5-ft. siphon to carry the existing Salt Creek sewer under the tunnel, a flow control chamber and two-barrel cross connection to the existing West Side intercepting sewer, a connection to the existing Laramie Ave. sewer, and an outfall structure and a three-barrel crossing under the canal.

Screen chamber as shaft

The screen chamber was used as a hoisting shaft for removing muck from the six barrels leading to the pump house, the branch sewer and 120 ft. of the west end of the two-barrel main sewer. Muck was hoisted in mud boxes by crawler crane and dumped in the excavation around the screen chamber structure until it was filled to normal ground surface, and the remainder was hauled to the spoil area. The six barrels connecting to the pump house were built two at a time from the screen chamber, using two 30-ft. sets of steel forms and one pneumatic placer moved into either barrel when ready to fill the forms. The 4x5-ft. siphon to carry the existing Salt Creek intercepting sewer under the tunnel was built by sinking the two risers to an elevation 10 ft. below the bottom of the main tunnel and mining the 4x5-ft. barrel from the risers. Concrete bulkheads were then built in the Salt Creek sewer to divert the flow through the siphon, and the abandoned section of the old sewer was removed when mining the main tunnel.

Both the connection to the Salt Creek sewer and the flow control chamber at the cross connection with the West Side intercepting sewer were built in open cut. The cross connection consists of two barrels 10x12½ ft. each, which were driven from the flow control chamber using mud boxes and a crawler crane for hoisting. The control chamber is fitted with timber check gates which will permit sewage to flow from the West Side system into the Southwest sewer but prevent flow in the reverse direction. The connection to the Laramie Ave. sewer, which is a part of this contract, includes a control chamber with six automatic float-controlled gates, two hand-operated sluice gates, a timber check gate and drop tubes connecting to both the West Side and Southwest sewers. This work was done in open cut with the Laramie Ave. sewer carried through in a temporary flume.

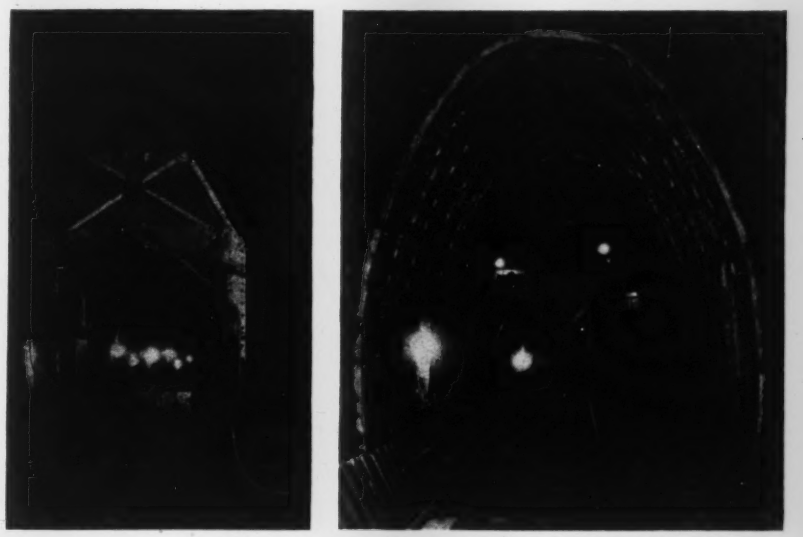


FIG. 5—CONCRETE LINING PLANT for contract 1 includes a traveling jumbo with hoppers to receive the mix from discharge pipes (left). When the jumbo is loaded, it is pulled by locomotive to the form (right) where the concrete dumps directly into the gun hopper. Note the simple plate and rib forms, which are moved and set up by the hopper gantry.

FIG. 6—TRUSS-BRACED COFFERDAM for the three-barrel section of the tunnel crossing under the Chicago Drainage Canal. The trusses, bolted to the sheeting, provide support for the runway carrying the pile-driving crane.

Unusual cofferdam

Because of the shallow headroom available to maintain the required 24-ft. depth for navigation in the canal, which is 300 ft. wide at this point, it was necessary to make the crossing in three 9x10-ft. barrels. Bottom of the finished sewer outside is 38 ft. below water level. This was built one half at a time behind a steel sheetpile cofferdam 45 ft. wide extending to mid-channel. The walls of 50-ft. steel sheetpiles were driven first, then trusses 10 ft. deep for cross bracing were assembled in pairs 8 ft. apart with horizontal braces, end girders and wales in place. The assembled pair was then lowered in place with the top chord at water level and attached to the sheetpiles by riveting through holes drilled after driving. Seven pairs of trusses thus assembled were connected to the piles as driving progressed toward mid-channel, and a timber roadway was laid on the trusses to carry the crawler crane used for handling the air hammer and for excavating with clamshell bucket (Fig. 6).

The end of the cofferdam was closed with two lines of sheetpiling 9 ft. apart braced by four horizontal trusses. Steel knee-braces from the center point of the bottom chord, two additional wales and the bracing between vertical legs of the

knee-braces were placed as unwatering and excavation progressed. Mixed concrete was delivered from the central mixing plant by dump trucks operating on the timber roadway. When the first half of the crossing was completed and the end of the finished section closed with a timber bulkhead, the sides of the cofferdam were dismantled and used for the second cofferdam, permitting navigation through the north half of the channel while the remaining portion of the crossing was built.

Another river crossing was built in West Pershing Rd. on Contract 4. A steel sheetpile cofferdam 29½ ft. wide was built to midstream and excavated 32 ft. below water by hand, wheelbarrows and a standard double-cage builders' hoist handling the muck. The dam was transversely braced by steel and wood trusses 9½ ft. deep placed about 8 ft. apart and stiffened with knee-braces. A double bulkhead of steel sheetpiling closed the end of the dam and was used for making the connection with the completed first half.

Direction

Design and construction were started under the direction of Philip Harrington, chief engineer, and are now being directed by Wm. H. Trinkaus, acting chief engineer, Walter H. Faget and H. P. Ramey, assistant chief engineers, O. L. Eltinge, engineer of sewer design, P. F. Girard, senior civil engineer and Langdon Pearse, sanitary engineer. Field work was in charge of Mr. Faget and W. C. Miller, principal construction engineer, and the following as resident engineers: Jos. H. Richmond, Contract 1; V. E. Gunlock, Contract 2; N. M. Newlands, Contract 3; R. F. Kelly, Contract 4, and J. W. Grimm, Contract 5.

Contractors were: Contract 1, Herlihy Mid-Continent Co., Contracts 2, 3 and 5, S. A. Healy Co.; and Contract 4, Leo Michuda & Son.

Carl H. Bauer is state director of the PWA for Illinois; Joshua D'Esposito represents the PWA as resident projects engineer in charge of the sanitary district project, and W. J. Reintjes is supervising engineer, inspection division, PWA.

The Engineer on the Witness Stand

Special qualifications that should be developed by engineers who may be called to appear as expert witnesses before public utility commissions or in court cases

By Martin T. Bennett

Gas and Water Utilities Engineer, Public Service Commission of Wisconsin, Madison, Wisc.

ENGINEERS *frequently are called to the witness stand to defend valuations that they have made of the property of public utilities whose rates are under investigation by regulatory commissions. Less frequently they are called into law courts as experts to testify as to why a certain building failed or a dam collapsed. Past history has shown that the large majority of engineers who have been so called have fallen far short of what was to be expected of them, not for lack of technical skill but because they lacked ability to convince the court or commission. They fell victim to the wiles of lawyers who are skilled in breaking down the testimony of witnesses. In the following article, Mr. Bennett, as the result of experience in utility valuation work, sets forth clearly what an engineer on the witness stand should do and what he should avoid. All that Mr. Bennett says applies with equal force to testimony in law courts or in patent suits.* EDITOR.

THERE IS AN OLD SAYING that is as true as it is old: "A valuation is only as good as the testimony supporting it." No matter how carefully and skillfully a valuation has been prepared, it becomes valueless as evidence if it cannot be supported by testimony that breathes confidence in it, and is convincing to the tribunals that are to pass upon it. The purpose of this discussion is to assist those who may some day be called upon to testify by pointing out the more important legal and psychological factors involved in testifying, so that the value of the work which they do in preparing to testify may be utilized to its fullest extent.

An engineer on the witness stand must be more than a good engineer. He must be somewhat of a lawyer, an accountant, an orator, and a showman. Yet he must not exaggerate any of these lest he be accused, mentally at least, of substituting proficiency at one or more of these for a deficiency in his engineering ability. He must understand thoroughly the purposes for which he is there, and he must know his rights and duties as a witness. His conduct, his manner and mode of speech, and his apparent attitude strongly influence the amount of credence which is placed in his work both by those who hear his testimony and by those who later might read the transcript. A transcript that is shot full of remarks such as: "Speak up please so the reporter can hear you," or is full of quibbling answers indicates that the witness did not have confidence in his own testimony or was trying to hide something. The best piece of work can be made to appear valueless upon the transcript as well as to those who actually hear the testimony by a combination of a good cross-examiner and a poor witness.

The engineering testimony with which I am most familiar relates to valuations. For that reason valuation work will be discussed almost exclusively, but the general principles so illustrated are applicable to almost all testimony. Testimony in valuation work may be given in public utility commission hearings or in a court. The latter might be thought to be more difficult, but as a matter of fact the witness has some rights in a court that are not extended to him ordinarily in commission hearings. The lack of formality in commission hearings can be taken as an advantage by the lawyer as well as by the witness.

The engineer's functions

In either commission or court cases, the function of the engineer is to give testimony and to prepare exhibits that become part of the evidence. Evidence is that which tends to show the existence or non-existence of pertinent facts. Evidence may be in the form of facts from which an inference may be drawn regarding the existence of the ultimate or main fact which is in dispute, or it may be in the form of opinions. In order for opinions to be of value they must be substantiated by showing: (1) The qualifications of the one expressing the opinion which make him an expert competent to give a valid opinion; (2) The reasoning or logic by which the opinion was reached; and (3) The basic facts from which the opinion was drawn. The basic facts

may be stated hypothetically, they may be stated as matters of the witness' own knowledge, they may have been proven by prior evidence, or they may be matters of common knowledge.

Clear logic needed

As far as the engineers are concerned, the primary fact to be established by public utility commission proceedings is the value of a property. The engineer makes his estimate of value of the physical property which is material evidence tending to prove a value which the commission itself must find. The engineer assembles the facts and organizes them in a way that tends to show a certain value. In many cases, these facts which he assembles are not in themselves susceptible of proof, but their existence is strongly indicated by other facts; and the engineer, having been qualified as an expert, is allowed to use his judgment or opinion. In such cases he must be prepared to justify the conclusion he reached by showing the process of logic by which he went from undisputed facts or from facts of common knowledge to his conclusion.

The written valuation which an engineer submits and which is entered into the record as an exhibit is really material evidence only so long as it is unchallenged. Since this is almost never the case, the valuation becomes a memorandum which alleges the existence, as a matter of the engineer's knowledge and opinion, of a lot of facts. Any number or all of these allegations may be disputed by interested parties. In fact, a conclusion or finding can be based upon unproven allegations only in a case which has been defaulted. A default is almost unheard of among commission cases, because the commission is a fact-finding as well as a judicial body and is consequently duty bound to make its own investigation where insufficient evidence has been introduced. The commission itself may dispute the allegations. Disputation may take the form of evidence tending to show that something different is a fact or may take the form of cross-examination tending to show that the allegations are not founded on fact or are illogical conclusions.

Orderly presentation needed

The purpose of the direct testimony is to indicate the accuracy with which the conclusions expressed in the valuation have been drawn. This testimony should be very carefully prepared and in important cases should be submitted for suggestions and criticisms to counsel for the witness in the form of written narrative sometime before the hearing. The purpose of writing it out before hand is to provide a means for organizing an orderly presentation and to inform counsel of what the witness has to say so that he may frame his questions in a manner that will make an orderly record. If the testimony flits around from high spot to low spot and back over the same ground again, no person of ordinary intelligence can get a clear impression of anything other than the confusion of the witness' thought. On the other hand, the testimony should not be memorized because in all probability the witness will be interrupted several times and the manner of presentation may be changed because of developments during the hearing.

A witness is allowed considerable latitude on direct examination. Counsel generally will frame the questions in a manner that will allow the witness to expand upon the train of thought which the question starts. Advantage should be taken of this where important details are involved, but not in relatively minor matters. A cryptic answer may force counsel to a line of leading questions which will bring objections from the other side and will be disturbing to his line of thought as well as to that of the witness. On the other hand, a witness who rambles on about relatively minor matters is destined to be mired in words where he makes an easy target for a good cross-examiner.

Qualifications of the witness

Generally, the direct testimony starts with a statement of experience and qualifications of the witness. This consists of a statement or a series of statements about the training and work that the witness has done in the past with emphasis upon the experiences that have been in a field similar or allied to that under consideration. This is not an opportunity to brag nor is it a time to be self-consciously modest. The witness should be just as matter-of-fact as if he were telling about someone else—neither praising, defending, nor depreciating what that person had done. Those experiences that indicate solely the confidence which has been placed in him should be enumerated in a general manner. Those experiences that are similar to the present case should be presented in more detail and similarities should be indicated if not expressed.

The next in order is a definition of the responsibilities of the witness in connection with what he is to testify about. If details were done by a subordinate, the witness should state that the work was done under his direction. If the witness actually did a large amount of the work but had help of calculators, field inventory men, etc., he may state that he did the work with assistance. In some cases, the witness will testify regarding the results obtained from work of someone else, but may not want to take responsibility for data and methods used. In such cases the witness should state that the figures were reported to him by this other person and that responsibility for them lies with the other person. Where a witness has testified that work has been done under his direction, he takes responsibility for a great amount of the detail which may be asked for, although, if some particular part of the work receives a large amount of attention, the subordinate who did the work may be called to the stand. Conversely, if a witness has worked under supervision or has received advice and instructions from a superior, he should say so. This leaves the way open to call the superior to the stand in order to testify about matters for which the subordinate is not competent.

Division of the testimony

Testimony regarding the work itself should be reported by divisions. Any general statements regarding methods which were used throughout the job should be stated first. Then it is well to say that the work naturally falls into certain divisions such as structures, production equipment, distribution equipment, etc. Then each division may be taken up in order. The amount of time and testimony devoted to each of the divisions should be determined by the significance of the result. Thus if there is no other valuation which shows differences from that of the witness, the amount of time and detail should be determined by the dollar amount involved. However, if a certain portion of the work differs widely in result from some other evidence, considerable time should be spent explaining methods, thus, incidentally, but not obviously, giving the advantages of the methods which were followed by the witness.

Stating advantages of one method over someone else's method is a delicate task. Care should be taken as far as possible to avoid giving testimony about someone else's work because it encourages the cross-examiner to try to show that the witness is not acquainted with the other work. This can be done easily in a complicated case by asking somewhat vague questions about details and then by showing that the answers are not accurate. It is far safer to state the other method as though it were a hypothetical case and to then state the advantages of method employed by the witness. If the witness is asked regarding the similarity between the hypothetical method and the one he is indirectly criticizing, he may reply in a general way about the similarity.

Vulnerability of the direct testimony may be greatly reduced by anticipating cross-examination. If the witness' work has any short-comings, it is well to call attention to these, rather than wait for cross-examination to do this. An opportunity is thereby given to the witness to depreciate the short-comings to the fullest extent, either by showing that they are not material or are in-

significant in relation to the entire work. However, care should be taken to avoid any appearance of apologizing for the work.

The most difficult part of giving direct testimony is the placing of proper emphasis on the more material part of the evidence. The part of the work that might have been the most difficult and most interesting to the witness may not be in issue. Hence the forgivable pride of the witness in that phase of the work should not be allowed to tempt him into a long dissertation that dulls the auditors' senses to an extent that insufficient attention is given to the significance of the testimony regarding contested issues. Often a table showing wherein the differences between two valuations lie is a good aid to organizing direct testimony.

In planning direct testimony, help may be obtained by setting up what one might call a standard of significance. Where this standard is to be set depends entirely upon the importance of the case, and upon the importance of the testimony with relation to the whole case. Help may be obtained by talking over with counsel the proposed testimony, the importance of the case and the part the witness is to play. When the witness has a fairly definite idea of what his standard of significance should be, determination of whether or not parts of the proposed testimony measure up to this becomes almost an automatic mental process.

The background of facts

All testimony should take the form of referring results back to what the witness believes to be undisputed facts. Thus to say that the value of a piece of equipment was obtained from certain sources of prices by a certain process or computation immediately divides the proof into two parts. The sources of prices may be undisputable or may appear to be. Then for the time being at least, that part of the evidence is proven. The process by which the value is obtained from the prices may be based partially on undisputed methods and partially on methods that required the use of judgment. Emphasis should be placed upon what is expected to be undisputed or is empirical so that the opinions of the witness that are not susceptible to definite proof do not appear to have had too much effect upon the answer. Courts prefer to form their own opinions. In fact, they seem to delight in over-ruling opinions of highly regarded authorities and experts on the strength of well marshalled facts which they can recognize in other forms of evidence.

While the witness is given leeway on direct examination, opposing counsel has the advantage on cross-examination. His aim is to draw out and emphasize the weaknesses in the witness' work and thus tear down its value as evidence. His questions can be as leading as he wants to make them, and he has scored a serious blow if he can force the witness to make an apparently untrue or contradictory statement. The opportunity to repair the damage which has been done is afforded by re-direct testimony and the witness should not try to worm-in explanations against the wishes of the opposing counsel. Probably the hardest part of testifying under cross-examination is resisting the impulse to give an explanation to say why such-and-such thing was done as an answer to a question of what was done. Better is it to answer the question directly followed by "because" and to add the explanation, if counsel allows it. If he does not, witness' counsel can make a note of the point to be drawn out on re-direct examination. Generally an attempt to explain is not advisable except where the questioning has made it appear that part of the evidence is poor and is significant.

A great amount of inaccuracy, expense, time, and effort could be saved if the first direct and first cross-examination in commission cases were required to be submitted and exchanged in writing before the hearing, and that subsequent examination be limited to matters which are germane to the written examination. Far too much is wasted as a result of the efforts of lawyers with weak cases to fill the record with masses of questioning on inconsequential details. While this is not done to any extent now, engineers may demonstrate the value of this by submitting as an exhibit with their valuation, a written report on the valuation which states in considerable detail the methods that were used in much the manner that it would be presented in direct testimony. When this is done, it is not necessary to avoid technical language in the written part, because the report in all probability will be turned over to engineers on the other side.

A game of wits

Assuming that a witness has his subject well in hand, one might generalize that the extent to which his testimony stands up under cross-examination will be determined by his attitude and conduct on the stand. In nearly all matters the witness must choose a balance between two extremes of conduct, either of which might prejudice the tribunal against his testimony. It is a game of wits in which he must try to see several moves ahead. The rules of the game vary and cannot be written down and memorized, but are matters of judgment which must be influenced by the circumstances of the occasion.

Nervousness on the stand is not a matter to be worried about nor should any attempt be made to conceal it. Trying to suppress it will exaggerate it; taking it for granted will utilize it. In fact, if a sudden calm comes over a witness, he is likely to acquire a sort of mental torpor wherein he becomes an easy subject to suggestion and may find himself saying things he doesn't mean. Good lawyers are known to do their best work while they are nervous and on edge. The same should apply to good witnesses.

A new witness is often concerned about the proper degree of quickness with which he should answer. To be concerned about this, indicates a degree of selfconsciousness which should be eliminated. What should concern the witness is the ability to distinguish the importance of the question promptly. If the question is important or involved, he will be expected to take considerable time. In fact, if the question is very involved, he would be justified in an extreme case in asking the reporter to read the question slowly while he wrote it down in longhand. By doing this he can keep a mental finger on all of the qualifications in the question while he formulates an answer that will fit these qualifications. This might easily take five minutes. Simple questions should be answered promptly, although not hurriedly, because the auditors will naturally make allowance for what appears to be the witness' natural speed of response and rapidity of speech.

A good witness will not encumber his answers with unnecessary qualifications. Thus if he is asked: "How old are you?", he will answer: "Thirty-five." Whether he was thirty-five at his last birthday or whether that is his age at the nearest birthday is not important. Nor is it important to say thirty-five years, nor to give any of the other qualifications that might be thought of. If an apparent inconsistency should be pointed out later as the result of an unqualified answer, it is time enough to explain that the witness assumed everyone knew what he meant. In some cases it might be even better to forsake making the explanation if it is obvious that everyone knew what was meant and that the questioner was trying to make a mountain out of a molehill.

Quibbling is a method of evading a question by requiring that the question be unnecessarily qualified or be precisely framed. The distinction between precision of speech and preciseness of speech is necessarily fine, but it is one that must be made all during cross-examination. A witness who is extremely precise in his speech or who draws fine distinctions is bound to give the impression that he is hiding something or is trying not to reveal some weaknesses in his evidence. If weaknesses are present, it is better to show them in a straightforward manner, to prevent to a considerable extent their importance being exaggerated. The unknown is always suspected to be the worst.

Loquaciousness is to be avoided. It not only produces the impression that the witness is trying to cover a deficiency with words, but it puts a lot of material into the record that may be used to ensnare the witness. For example: A sentence unnecessarily prefaced with "In my opinion" is robbed of much of its value because the speaker thereby concedes that it is a matter of opinion and not of fact. Relatively few facts can be proven beyond any shadow of doubt, but that does not mean that everything else is opinion. Far more important than good grammar and the ability to use big words is the ability to express an idea in a few simple words. The aim of the witness on cross-examination as well as on direct should be to give information and to make everyone understand what he means.

A dogmatic or a patronizing manner should be avoided. In an over-zealous attempt to make himself understood, a witness runs the danger of appearing to think that he knows more than anyone else. One's argument becomes easily exploded, if room is not left for the other person's argument. A respectful attitude inspires respect in others.

While many necessities of conduct are a balance between two extremes that cannot be definitely defined, some precautions apply at practically all times. The witness should speak clearly, and slowly, much as if he were dictating. His answers should be positive and responsive. He should not allow himself to worry about the impression he is making. He is not in an argument. He is giving what he believes to be facts, the lawyers are doing the arguing and the commission or the court is forming the opinion or drawing conclusions.

Pumping Grandstand Concrete In Cold Weather

Thin seat slabs, ramps and walkways at Detroit ball park extensions poured from central plant through pipeline system

By Emory D. Roberts
Professor of Civil Engineering, Marquette University, Milwaukee, Wis.

PLACING concrete during extreme cold weather by the pumping method proved practicable last winter in the construction of additional grandstands at the Navin Field ball park, Detroit. Caught short by the lack of adequate seating facilities for the world series games of 1935, the management of the Detroit Tigers determined to complete the horseshoe of steel and concrete stands started some years ago to bring the total seating capacity of the park to 36,440. The additional construction involved the building of two sections of double-decked covered grandstands and the addition of a second deck to a section of bleachers, all to be ready for the opening of the 1936 season in April.

After the decision to proceed with the new construction had been made and designs were under way, the project was halted by the death of F. J. Navin, managing owner of the Detroit team. The ensuing delay, during which the club was reorganized, cut heavily into the already short time available for design and building of the additions. The new management decided to go ahead with the new work, though construction operations would have to be carried out during the cold-weather season.

Design

The new grandstands are made up of three units. Section A, which extends from the old concrete stands to the foul line, has two decks, a press box and a roof, the floor of the press box being 90 ft. above the playing field. Section B, of the same height, is somewhat narrower and has two decks, a press box and a roof. It fills the space between the old concrete bleachers and the foul line at the rear of right field These concrete bleachers (Sec. C) have been double-decked with a second deck that will not be covered for the present. Steel supports of the upper deck of the bleachers are independent of the old concrete columns carrying the lower deck.

The structures are of steel framework with concrete ramps, walkways and seat treads (Fig. 2). Several innovations in design are of interest, particularly that of tread and riser detail, as shown in Fig. 3. Steel risers of ¼-in. plate are supported on sloping channel floorbeams by gusset plates and clip angles. Continuous 2x2-in. angles, spot welded to the steel risers, carry a 3/16-in. tread plate. Upon this plate is a 2-in. concrete tread, for which the steel plate served as forms. The concrete treads are reinforced with No. 10 wire mesh. Joints placed every 30 ft. provide for contraction and expansion of the concrete treads.

Special chairs were installed in the covered sections. Their frames are fastened by lugs through slotted holes in the steel plate risers. The clear tread thus formed reduces the labor of cleaning. Similar slotting of the risers of the upper deck of the bleachers provides fastening for an angle supporting the 8-in. plank seats installed in this section.

Steel for the structures began to arrive by the first of this year, and erection commenced at once. By Jan. 15 about 75 per cent of steel for the larger grandstand was in place and much of

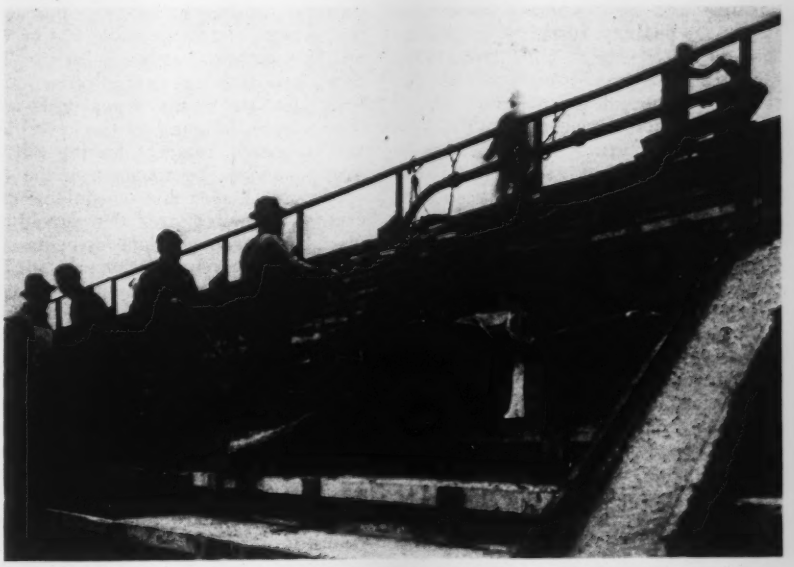


FIG. 1—CONCRETE PUMPED to top of new bleachers at Navin Field, Detroit flows through short chutes to final position in seat treads. The tread forms are fastened to steel risers through slotted holes that later will be used for seat fastenings.

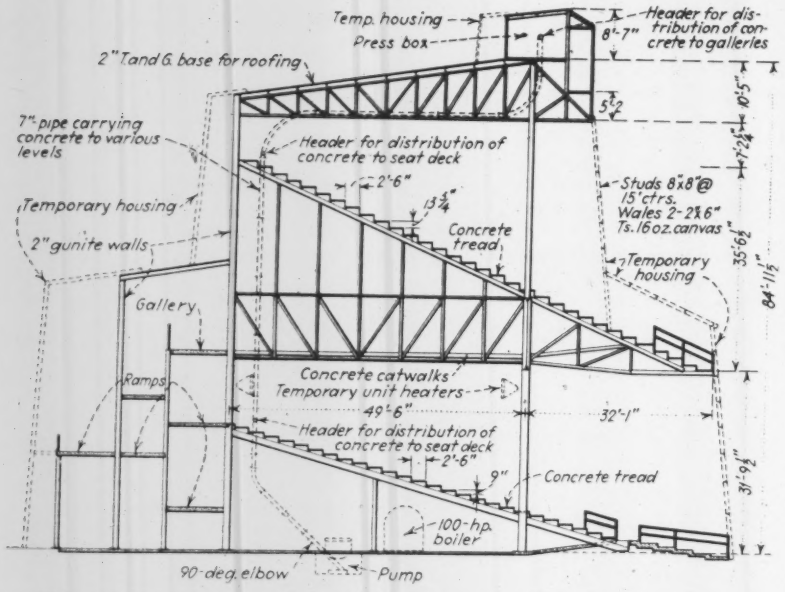


FIG. 2—NEW STANDS for Detroit ball park are structural steel, with concrete seat treads and ramps. This cross section shows the plant layout for the concrete pumping distribution system. The stands were enclosed in canvas housing and heated by unit heaters during construction.

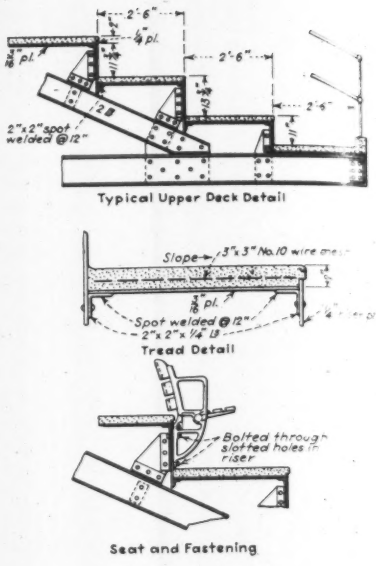


FIG. 3—UNUSUAL DESIGN of the seat treads shown in detail. The seats are bolted to steel risers, which leaves the tread clear for easy cleaning.

the seat deck area was ready for concrete. At first the tower-and-chute method was considered for distribution of concrete. However, as the weather was extremely cold, with no signs of a break, the contractor decided that the loss of heat in the concrete by bucket hoisting and long chuting would be excessive, possibly resulting in serious damage by freezing. Furthermore, as the structures would have to be enclosed and heated to maintain proper concrete curing temperatures, the efficiency of the heating system would be impaired by keeping the top of the housing open, as would have been necessary to handle the chutes.

The contractor finally adopted the pumping method as best suited to the requirements of wide distribution with minimum heat loss. The plant arrangement was to place the concrete pump below ground level in a pit centrally located, and to install a 7-in. vertical riser pipeline from pump to highest point of concreting, with horizontal headers leading off from the riser through quarter bends at various levels, as shown in Fig. 2. Chutes conveyed the concrete from headers down the inclined seat decks to points of placement. Additional pipe elbows changed the direction of flow when pouring ramps and catwalks.

Concrete was mixed in truck mixers with heated aggregates obtained from a central batching plant some distance from the job. The movement of mixer trucks was controlled so as to avoid delay at the pump and resultant loss of heat. The trucks discharged directly into the remixing hopper of the pump machine. Provisions were made for insulating the concrete pipelines if necessary, but experience showed that the loss of heat in the longest of the lines was only two or three degrees temperature between pump and point of placement.

The concreting schedule called for pouring the floor of the press box first. Catwalks leading to the press box were placed next, and the pipeline was broken up as operations moved back. The upper seat deck was next in order. Catwalks leading to the upper deck were then poured, followed by the lower deck and approach ramps. Paving of the ground under the stands was the last operation. Under this schedule no concrete was poured over that already in place, and trouble from dripping and spotting of new work was avoided. Despite the prolonged cold spell, the concreting kept up to schedule and the structures were completed within the allotted time.

The pump forced concrete to the highest points of the stands without difficulty. At one time it was working with 367 ft. of 7-in. pipe, including a vertical rise of 101 ft., with five 90-deg. bends in the line. In all, 1,300 cu.yd. of concrete was pumped, most of the yardage being in the 2-in. seat treads. Concrete was of two mixtures, both of a strength requirement of 2,800 lb. per sq.in. in 28 days. For the seat treads the maximum size aggregate was ½ in.; for the walks and ramps it was 1½ in.

For temporary heating during concrete placement and curing the two grandstands were completely enclosed by timber and canvas housing. This consisted of 8x8-in. studs spaced 15 ft. apart, carrying wales of two 2x6-in. planks spiked together in the form of a T. The timber frame was covered with 16-oz. canvas. A 100-h.p. boiler supplied heat through unit heaters placed throughout the stands (Fig. 2). The upper deck of the new bleachers was not enclosed, but fresh concrete was protected by tarpaulins, as shown in Fig. 1.

Direction

Both the design and construction of the new facilities were carried out by the Jerome A. Utley Co., of Detroit. P. C. Darin, general superintendent, Geo. Baseman, Geo. Armstrong and J. A. Fredman were the officials in charge of the work for the Utley company. The writer is consulting engineer for the Chain Belt Co., Milwaukee, which supplied the concrete pumping equipment.

Havana to Study Water Supply Plan for City

THE MAYOR OF HAVANA, CUBA, has just announced the appointment of a commission ot study the problem of water supply for that city and prepare a report on the cost of the necessary equipment, method of financing and other details connected therewith, according to a report to the Department of Commerce from Charles H. Ducote, assistant commercial attache, Havana.

The plan proposes the creation of a sub-commission of engineers who will study the problem and report their findings to the main commission personnel, the report states. It is expected locally that the report will be ready for presentation to the mayor early in 1937.

Midwest Sewage Meeting Features Research and Design

Wide variety of topics including high-rate trickling filters, sludge-gas engine operation and factors affecting B.O.D. determinations discussed at two-day meeting in Indianapolis

A GENEROUS QUOTA of research, design and construction papers and a minimum discussion of operation problems characterized the Central States Sewage Works Association meeting at Indianapolis on Oct. 29 and 30, attended by 150 operators, superintendents, chemists, research experts and other operating and administrative officials.

A gadget exhibition with cash awards was a feature. Gus H. Radebaugh, secretary-treasurer, reported net worth of nearly $800 and 241 members. Although W. W. DeBerard, representative to the board of control of the Federation of Sewage Works Associations reported a defiicit of some $600 in the budget of the *Sewage Works Journal* no increase in dues was authorized, as had been done recently by the New York, Pennsylvania, California, New England and Rocky Mountain associations, to cover the Central States share which can easily be met from surplus. Dues remain at $3 for active members.

A plea was made to officials to employ only competent personnel and to assure continuous tenure of office so long as the employe was competent. The Federation was requested to work with the American Society of Civil Engineers and the American Public Health Association on a revision of the 1928 manual giving definitions of sewage and sewage treatment terms. The next meeting will be in the Twin Cities. Newly elected officers are as follows: President, Prof. H. E. Babbitt; vice presidents: Prof. F. M. Dawson, George J. Schroepfer and B. A. Poole; secretary-treasurer, Gus H. Radebaugh, Urbana-Champaign, Ill.; James L. Ferebee and W. W. DeBerard, representatives to board of control of the Federation of Sewage Works Associations.

Technical program

On the technical program were papers describing installations at Kokomo, Ind., Madison, Wis., Dayton, O., and Janesville, Wis., research on high-rate trickling filters, industrial waste pollution, and operation of a newly installed sewage gas engine at Aurora, Ill.

M. N. Tatlock, superintendent, detailed the addition by WPA of secondary processes to the Dayton, O. sewage plant including twenty trickling filters, 165 ft. in diameter and 7½ ft. deep, four final settlings basins, 80 ft. in diameter and 9 ft. deep, providing 1½ hr. nominal detention and two sludge digester tanks. The city put up $100,000 cash and got credit for an equal amount for sand and gravel from the excavation and supervision. Mr. Tatlock claims the work was done at about contract prices.

J. L. Ferebee, chief engineer, Milwaukee Sewerage Commission, described the latest aditions to the Milwaukee plant at Jones Island built on made-land and supported on piles.

In a paper by Joseph Lustig, city engineer, on Janesville's (Wis.) part in the clean-up of Rock River a novel method of stopping leaks in 40-yr. old concrete pipe intercepters 48 and 54 in. in diameter was described. Short sections were dammed off and lead strips driven into the chipped-out joints. Leakage was reduced from 4½ m.g.d. to 1 m.g.d. in the larger line and from 3 m.g.d. to 1 m.g.d. in the 48 in. line. Cost was $2.98 per joint.

The new Kokomo sewage treatment plant consists of screens, grinders, grit removers, rotary trickling filters, final settling tanks and a sludge incinerator wherein garbage also will be burned. Russell B. Moore, consulting engineer described the installation.

H. O. Halvorson, associate professor of bacteriology at the University of Minnesota, described his trickling filter experiments through which continuous rates up to 26 m.g.d. per acre were obtained. He concluded that rest periods were definitely deleterious. His up-and-down experiments with air currents were criticized by W. D. Hatfield, Decatur, Ill., as not of practical significance in large beds. W. A. Sperry, Aurora, Ill. checked the observation that quiescent periods are injurious but he noted that his filters were normalized within 2 days after several months idleness.

Dr. F. W. Mohlman, chief chemist, Sanitary District of Chicago, detailed a year's operation results with high rates of Imhoff effluent applied to a 10-ft. diameter experimental tank 8 ft. deep fed through four rotating arms onto a 2 to 3½-in. stone bed at rates of 20 and 27 m.g.d. per acre. B.O.D. was reduced from 98 p.p.m. in the raw sewage to 13 p.p.m. in winter and 27 p.p.m. in summer by the combined treatments, the Imhoff tanks caring for half of the reduction. He considered the filters as a biological flocculator.

Following a historical recital of "first" installations of various sewage treatment processes L. H. Enslow, president, New York State Sewage Works Association, spoke briefly on future trends. River boards to handle complete watersheds as in England and better cooperation between industries and municipalities were noted.

The Aurora (Ill.) plant described by W. Sperry, superintendent, now obtains most of its power from a newly installed 70-h.p. high speed sewage digester-gas engine with the throttle float-controlled to regulate speed to quantity of sewage flowing. The gross cost was $12,700 partially financed by PWA. Instead of a standby supply of gas from the local gas company, a 500-gal. gasoline tank was installed outside the station. Heat exchangers were installed through which heat is transferred to the digestion tanks.

Last year Dr. M. Starr Nichols, chief chemist, Wisconsin State Laboratory of Hygiene, reported fully on the much increased B.O.D. in certain sewages to which minute portions of phosphorus and nitrogen were added. This year he and W. L. Lee, assistant chemist, reported results of experiments on mixtures of black liquor of paper mill wastes. B.O.D.'s of sewage and waste were 481 and 280 but when mixed in equal proportions B.O.D. was increased to 820 p.p.m. The observation has significance in determining sewage rental charges where these are based on B.O.D. of industrial wastes. Dr. Mohlman indicated that in consequence of Dr. Nichols' researches definite knowledge of the mineral content of streams into which effluents might be discharged should be known.

George Washington Bridge Shows Traffic Gains

WHEN the George Washington bridge completed its fifth year on October 24, nearly 31,000,000 vehicles had crossed the bridge since its opening. Traffic for the year ending October 24, 1936, amounting to nearly 7,000,000 vehicles, was 22.5 per cent heavier than in the first twelve months that the bridge was in operation.

Since the first curiosity-rush at the time of the opening, pedestrian traffic on the bridge has held nearly constant at about 120,000 per year. The large pedestrian figures for the first year bring the five-year total up to 968,000.

The most startling expansion has been in bus traffic over the bridge. The last four years has seen an increase of 170 per cent, traffic increasing from 215,000 buses per year in 1931-32 to 582,000 in the last twelve months. In the past year about 11,638,000 passengers have been carried over the bridge in buses.

Venturi Measurement of Raw and Digested Sludge

Baltimore investigation reveals venturi meters can be used satisfactorily for measuring dense sludge mixtures without danger of clogging

By C. E. Keefer
Bureau of Sewers, Baltimore, Md.

VENTURI METERS have been in general use for many years at sewage treatment works for measuring sewage and activated sludge. Engineers have been hesitant, however, to install venturi tubes for measuring raw and digested sludge, which usually contains from 4 to 10 per cent of solids. The fear has been that solids in the sludge might clog the piezometer rings and the holes which connect these rings with the inside of the meter tube. Several 6 x 4-in. venturi tubes were installed in the North Side plant in Chicago, Ill., for measuring the sludge from the preliminary settling tanks. Many unsuccessful attempts were made to operate these meters. On the other hand, both raw and digested sludges were metered satisfactorily at Grand Rapids, Mich.

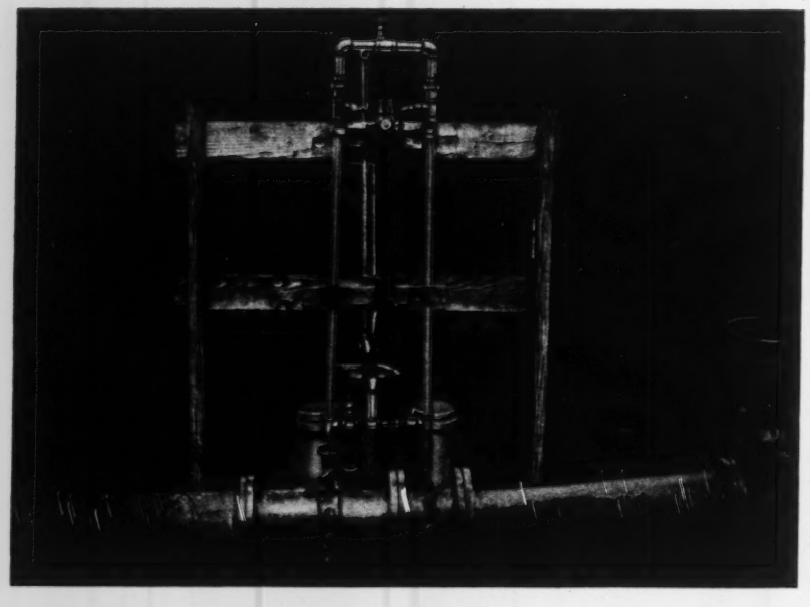
The usual method of determining the volumes of raw and digested sludge produced at a sewage-works is by making volumetric measurements. Under certain conditions this method may be subject to considerable error. Furthermore, at many plants the amount of sludge handled cannot be determined in this way.

The patent desirability of having some accurate and satisfactory means of measuring sewage sludge prompted the making of a series of tests at the Baltimore sewage works when pumping sludge through a venturi tube. These tests were made with a standard 8 x 4-in. venturi meter installed in an 8-in. cast iron sludge force main. Practically no difficulty was experienced with the clogging of the piezometer rings on the meter. Results indicated that the error in determining the volume of sludge by the meter as compared with volumetric measurements varied from −5.0 to +7.3 per cent.

COMPARISON OF VOLUMETRIC AND VENTURI METER MEASUREMENTS SHOWING PERCENTAGES OF ERROR

Run Number	Length of Run	Moisture in Sludge	Sludge Measured By Volume	Sludge Measured By Venturi Meter Tube	Error
		Date: July 9, 1936			
1	36 mins.	94.5%	42,650 gal.	45,760 gal.	+7.3%
2	32.5 mins.	94.1%	42,650 gal.	41,380 gal.	−3.0%
		Date: July 28, 1936			
3	35.5 mins.	96.2%	42,650 gal.	44,660 gal.	+4.7%
4	34.5 mins.	95.0%	42,650 gal.	40,510 gal.	−5.0%

VENTURI TUBE INSTALLATION for making sludge measurement tests. Both rings of the meter were connected with small (6-in. pipe) sedimentation chambers, and these in turn were connected with a mercury manometer. A 1-in. water pipe supplied clean water to the piezometer rings



The venturi tube installation

The venturi tube was installed in the pipe line about 42 ft. from the discharge end. At the outlet of the main there was a 90 deg. elbow, to which was attached a short pipe pointing upward for the purpose of producing a pressure at the downstream end of the meter of about 2.5 lb. per sq. in. The venturi tube was laid in a horizontal position with 25 ft. of straight pipe beyond the upstream end and the first bend. There were four ¼-in. holes connecting the inside of the meter with each of the piezometer rings. From each of these rings a 1-in. pipe connected with a small sedimentation chamber, made of 6-in. steel pipe, 18 in. long. A 1-in. diameter pipe united each sedimentation chamber with a mercury manometer. These pipes were connected to another pipe, through which a small quantity of clean water flowed. This water passed through a $\frac{1}{16}$-in. orifice, with one in each pipe. A small current of clean water, therefore, flowed from a point near the manometer through the above-mentioned pipes to each of the piezometer rings and thence into the venturi tube. As the quantity flowing into each ring was the same, the manometer readings were not affected.

An 8-in. centrifugal pump was used for handling the sludge, which was drawn by gravity from digestion tanks into a suction well of known dimensions.

Procedure for making tests

The tests fall into two groups. Those in the first group, begun on Nov. 4, 1935, were of a preliminary nature, and indicated the procedure to follow when making the final and carefully controlled tests. During this preliminary period 4,770,000 gal. of raw, semi-digested and digested sludges were pumped for about 50 hr. over 10 days. Once a day at the beginning of each test all of the cleaner plugs on the piezometer rings were operated in order to remove any material that might have accumulated. The second group of tests was made primarily to determine the accuracy of the meter and also to see if the apparatus clogged.

A quantity of digested sludge was discharged into an open suction well 32 ft. 7 in. by 20 ft. 6 in. in plan. The sludge was pumped out of the well and through the venturi tube. The time required for the surface of the sludge to fall 8 ft. was recorded. All vertical measurements were made with a graduated steel tape. Manometer readings were taken every minute, and the aver-

ages were calculated for each run. Samples of the sludge were obtained every 3 min. and composited for test purposes.

Results

The results of this work, given in the accompanying table, show that the accuracy of the venturi meter measurements varied from −5.0 to +7.3 per cent. Some of this inaccuracy is accounted for by the specific gravity and the viscosity of the sludge being greater than water. The total quantity of sludge pumped was 170,600 gal. when measured volumetrically and 172,310 gal. as determined by the venturi meter tube. The average of all the meter readings was, therefore, about 1.0 per cent high. The most satisfactory phase of the work was that there was no clogging of the piezometer rings or of the pressure pipes to the manometer at any time during the tests. It is essential however, that there be a small flow of clean water into the venturi tube to prevent any solid materials clogging the meter.

Although the tests with this standard type meter were satisfactory, it is believed that even better results could be obtainable with an especially designed tube with large openings into the piezometer rings. The studies indicate that venturi meter tubes are applicable for measuring raw and digested sludge when the proper operating procedure is followed.

The Baltimore sewage-works is under the supervision of B. L. Crozier, chief engineer, department of public works, and G. E. Finck, sewerage engineer, with G. K. Armeling, superintendent. Acknowledgements are due the Builders Iron Foundry for furnishing the meter tube and the manometer used in these tests.

Concrete Pavement and Base Embody Latest Research

Pavement on recent Washington streets has taken into account the latest research and experience in concrete road practice

By H. F. Clemmer
Engineer of Materials, Washington, D. C.

IT IS A COMMON ASSERTION *that city practice in concrete paving falls below the standards set by state highway departments and the Bureau of Public Roads for concrete road-building. Avoiding for the moment dispute whether city paving generally has applied all that concrete road-building has developed regarding rational pavement section, concrete design and control, warping, moisture and temperature stresses and movements, joint design and crack control by reinforcement, an example is presented of concrete design for city paving that has taken account of every proved advance in state and federal concrete road practice. This is the newest concrete pavement and pavement base design in Washington, D. C., as described in a paper read at the recent fall meeting at Pittsburgh, Pa. of the American Society of Civil Engineers.*—EDITOR.

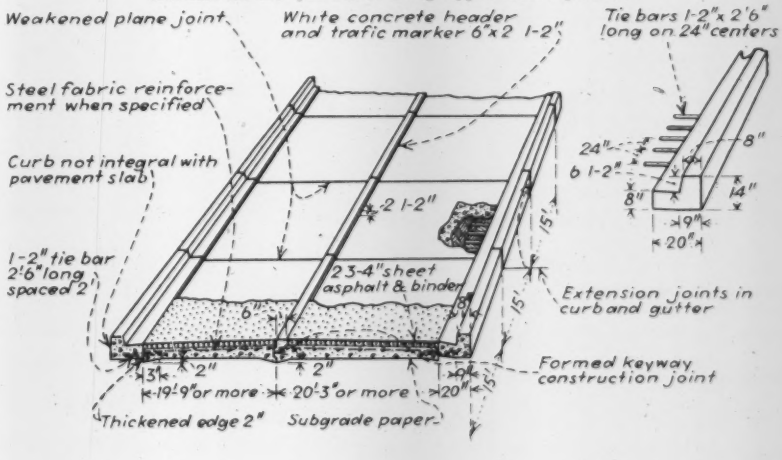
AS A RESULT of definite control of standards for road design and construction by the federal government in its administration of federal-aid funds, state highway departments are, in general, more advanced in their specifications for economical and efficient construction of concrete pavements than are municipal organizations. However, the recent cooperation of the federal government, through the state departments, in constructing main thoroughfares in municipalities has been an important factor in raising municipal road construction standards. In the pavement and pavement base designs discussed here the latest proved conclusions of concrete-road research and practice have been taken into consideration and made use of as they apply to city paving.

Pavement design

Concrete pavements as constructed in the District of Columbia are illustrated by Fig. 3. For all concrete pavements less than 40 ft. wide a 20-ft. center section with a thickened edge and a center longitudinal contraction joint is constructed. Side sections are tied to the middle sections with ½-in. diameter bars 3 ft. long spaced 5 ft. apart. The edge of the side section adjacent to the center section is thickened to equal that of the center slab; and gutter and curb are constructed integrally to eliminate the need for thickening the outside edge.

Bituminous impregnated paper is used to cover all subgrades before placing concrete. The use of this covering, which is negligible in cost, has proven of value in controlling the consistency of concrete and permits the use of a much drier mix. Variation in the ab-

FIG. 1—CONCRETE BASE for bituminous surfaces have in concrete design and slab structure all the qualities of a high-type concrete pavement



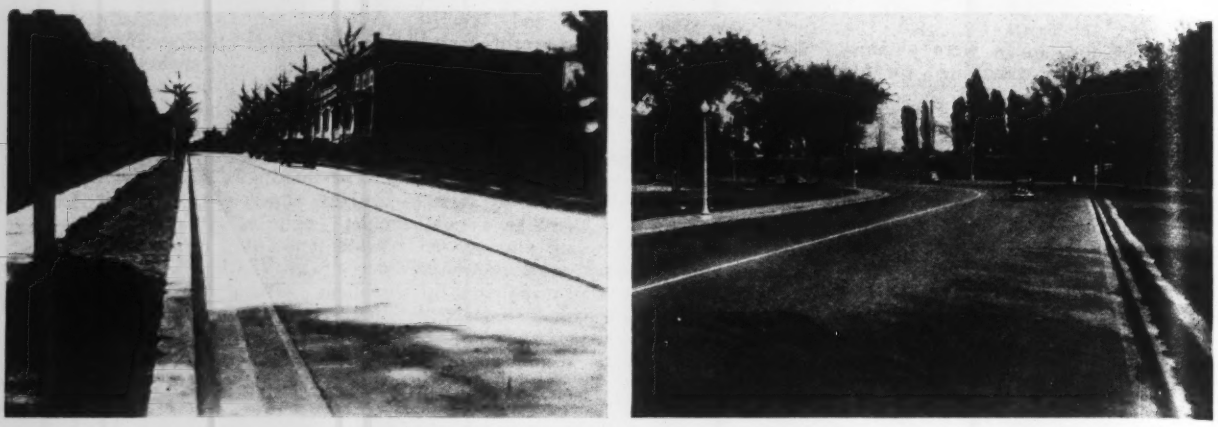


FIG. 2—CONCRETE pavement (left) and concrete base for bituminous surfacing (right), embodying latest proved practices in concrete design and construction, have given superior results in Washington, D. C.

sorptive characteristics of different types of subgrade causes definite variation in the consistency of the concrete unless the subgrade is covered with moisture-proof material.

Mesh reinforcing steel weighing 50 lb. per 100 sq. ft. is used in the construction of all concrete pavements.

Expansion joints of the metal air-cushion type using either dowel bars or the formed keyway for transfer of load are installed at 40-ft. intervals when concrete is placed at temperatures of 55 deg. or below. When the temperature at the time of construction is over 55 deg. expansion joints are placed at intervals of 60 ft., with contraction joints at midpoints, using the same design for the transfer of load and for sealing the surface as for expansion joints. Expansion joints are ½ in. wide rather than the usual 1 in., to effect more efficient load transfer. Where dowel bars are used they are spaced 12 in. apart.

All concrete road surfaces are finished by drawing a street broom lightly over the surface after final belting. This finish has a pleasing appearance and affords maximum traction and minimizes glare.

Specifications for the protection and curing of concrete require covering with layers of saturated burlap or the surface application of calcium chloride.

A factor of first importance in the construction of all roadways and particularly of municipal pavements is the necessity for early opening of the pavement to traffic. Specimens of concrete are made daily on each project and tested by field representatives. As soon as the results indicate that the design strength has been attained, that portion of the project is immediately opened to traffic.

Special study has been carried on to determine the most efficient methods of obtaining early-strength concrete. As an intersection is approached an accelerator is incorporated in the concrete mix for the last day's construction so that the section will be ready to open at the same time as the concrete previously poured. Intersections are poured with a mix containing one extra sack of cement per cubic yard as well as incorporating an accelerator. This practice permits the opening of pavement within 24 hr. and in many cases the pavement has been opened to traffic in as short a time as 8 hr., but never until the field tests of specimens from the same concrete have certified that proper strength has been attained. This practice has been found to offer the most practical and economical means of obtaining early-strength concrete.

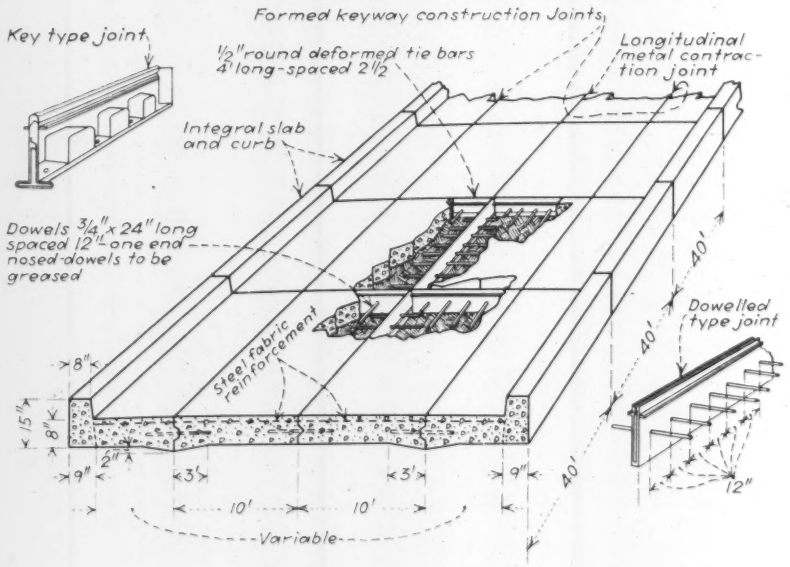
Several years of experience in making field-strength tests on concrete have shown that the development of early strength is considerably retarded when concrete is placed during low temperature. Therefore when concrete is placed during low temperature, calcium chloride incorporated in the mix is required in lieu of whatever method of curing is being used. When temperatures reach freezing the contractor is required to heat the mixing water or aggregates, or both, and to cover the surface of the concrete with straw. Concrete pavement has been very satisfactorily constructed under these specifications at temperatures many degrees below freezing.

Pavement base design

The Bates Road tests definitely proved that the same structural consideration should be given the design of concrete bases as is given to concrete pavement slabs. Wearing surfaces do tend to reduce the effect of temperature and moisture changes, but not sufficiently to permit overlooking any of the design principles applying to concrete pavements.

The need for properly-designed concrete to insure maximum durability is just as important for concrete bases as for concrete pavements. In the construction of the concrete bases on the

FIG. 3—SECTION of recent concrete pavement in Washington, D. C.; note the use of thickened edges, interlocking of slabs and reinforcement for crack control



world-famed Mount Vernon Highway the Bureau of Public Roads used a concrete having a unit cement content of 1.5 bbl. per cu. yd., which is the same as is used by many highway departments for concrete pavements.

As a result of numerous researches on durability of concrete, there has been a trend toward increased unit-cement contents, particularly for pavement-base mixes. Freezing and thawing action is one of the most destructive agencies affecting the durability of concrete. Such action is more destructive in temperate climates than in extremely cold climates, since not more than three or four freezing and thawing cycles may take place each year in the extreme northern localities; in contrast, in the vicinity of Washington, D. C., concrete may be subjected to 20 or more complete cycles of freezing and thawing. Both bases and pavements, of course, are subjected to the same deteriorating agencies. The above is presented to show that our pavement and base concrete should be of comparable quality; the only variation in design being the utilization of a thinner slab for bases in view of the fact that internal stresses set up by temperature changes may be somewhat minimized by the protection of overlying bituminous surfaces. The use of mixes with higher unit-cement contents does require consideration of the volume changes of concrete. Probably the main reason for the use of lean concrete mixes in the past has been the lack of a properly-designed expansion joint.

Several types of non-extruding expansion joint fillers have been developed recently and the practicability of installing these joints in concrete bases has been demonstrated. The highway department of the District of Columbia has been installing expansion joints and planes of weakness in all base construction for the past three years. The same provisions for transfer of loads are required for these expansion joints as for joints in concrete pavements. Consideration should be given to the fact that if the space between joints is sufficiently close, the movement at any expansion joint or plane of weakness will be but slight and it might not be necessary to require special provision for transfer of load if the dummy type of joint is constructed where a plane of weakness may be desired.

On one project where the subgrade conditions were unsatisfactory and the pavement was subjected to a large volume of heavy vehicles, expansion joints were placed at 40-ft. intervals with planes of weakness, including provision for transfer of load, at midpoints. This pavement has been in service for five years and though the freedom of movement of the concrete has caused cracks to follow through the sheet asphalt surface at some of the expansion joints, the pavement has proven structurally strong and has required no maintenance whatever for either base or surface.

The general specifications of the District of Columbia highway department require the installation of planes of weakness each 15 ft. with expansion joints at points of tangency, but not more than 300 ft., apart. The planes of weakness are made in the plastic concrete by forming a vertical groove or cleft for a depth one-half the thickness of the slab, either by installing a material such as paper, which is left in place, or by a suitable installing bar or device used to form a narrow groove or cleft which remains open. A cleft of this depth insures that the slab will crack at this weakened plane when sufficient stress develops. With such spacing of weakened planes the cracks separate but little, thus providing for load transfer due to the interlocking faces.

Surface cracking negligible

A survey of the pavements so constructed in the District of Columbia has shown that where the planes of weakness have been properly installed the movement of individual sections is so minute that cracking of the asphalt surface is eliminated, except for occasional regular cracks over expansion joints. These expansion joints must be non-extruding and should be placed flush with the surface of the base concrete in such a manner as to furnish continuous support to the surface. The surface cracks which may form over the expansion joints are straight and seldom open sufficiently to require maintenance.

The development of non-extruding expansion joint installations has made it possible to increase the unit cement content of concrete, as generally specified for pavement bases, and so provide a pavement of greater strength and durability. This department has used both the air-cushion type and the resilient type of expansion joint in concrete base construction with success.

Fig. 1 illustrates the design of sheet asphalt pavements as constructed in the District of Columbia. All concrete bases of 20 ft. or more in width are constructed in two sections with a traffic marker dividing the pavement width. The two slabs are joined by a longitudinal formed keyway, to prevent displacement of the surface. The curb is constructed separately and is tied to the slab by ½-in. bars spaced 2½ ft. apart.

All of the principles brought out in the design and construction of concrete pavements including thickened edges should be applied to the design and construction of concrete pavement bases.

Effectiveness of City Zoning Ordinances Investigated in Boston and Columbus

ZONING A CITY to limit its business district, to keep gasoline stations from over-running residence sections and to restrict factories to industrial sections, is a twenty-year old story that has been repeated in more than 1200 municipalities since the practice started. Few cities, however, have attempted to investigate the effectiveness of their zoning ordinance administration, to see whether or not the purpose of the regulatory laws has been accomplished.

Columbus, O., and Boston, Mass., were studied recently to gain a fair picture of the administration of their zoning ordinances, according to the American Society of Planning Officials. In Columbus, where zoning affairs were examined over the years 1923 to 1931 it was found that 59.5 per cent of the 757 appeals for exemption from or modification of the zoning regulations were granted by the zoning board. It was considered significant that 721 witnesses appeared favoring modification in the cases where appeals were granted, whereas only 293 witnesses registered favoring modifications in appeals that were denied. Over an eleven-year period, 1924-35, the Boston Board of Zoning Appeals granted 64 per cent of the requests for modification brought before it.

"The studies made in these two cities do not provide sufficient evidence for concluding that zoning regulations have no value," says Walter H. Blucher, executive director of the American Society of Planning Officials. "It would seem, however, that zoning boards of appeals are quite lenient in their decisions. This seems particularly true in Massachusetts, where, at the recent annual meeting of the Massachusetts Federation of Planning Boards much criticism was levelled against zoning boards of appeals for letting down the bars. Some zoning boards of appeals have been prone to forget that they are supposed to serve in a semi-judicial capacity, varying the terms of zoning ordinances only where there has been unnecessary hardship and have acted in a legislative manner, usurping the duties of the legislative body.

"The purpose of zoning is to provide an adequate land use program and to protect land against harmful uses and intrusions. Variances or changes made merely to increase the value of a single parcel of property may break down the ordinance so that it has little value."

Mountain Water For Little Rock

Rolled earth dam will impound 14 billion gallons of water, sufficient to meet a three-year drought—A 32-mile 39-in. concrete gravity pipeline brings water to existing filters now treating polluted Arkansas River water

TO REPLACE a highly polluted, hard Arkansas River water supply, Little Rock, Ark., is well on the way toward obtaining a soft impounded mountain supply. Essential elements in the new system are a 14-billion gal. reservoir back of an earth dam and a 39-in. reinforced concrete gravity pipeline slightly more than 32 mi. in length. With revenue bonds and a PWA grant the city in 1935 purchased the property of the Arkansas Water Co. for $3,850,000 and since April 1, 1935 has been operating the system and has put under construction the dam and pipeline. The project was described by Chester A. Smith, consulting engineer of Burns & McDonnell Engineering Co., at the Kansas City meeting of the Missouri Valley section of the American Water Works Association. The following are excerpts from that paper:

The Arkansas River, main source of the present water supply, rises in the Rocky Mountains of Colorado. However, before this clear, soft mountain water arrives at the waterworks intake at Little Rock, it has received additional waters from its many tributaries, which have accumulated a heavy turbidity content from the recently famous "dust bowl" area of eastern Colorado and western Kansas, carbonates and sulphates from hard water areas of Kansas, Oklahoma and Arkansas, various forms of pollution from cities and populated lands on its drainage areas, and also in the past thirty or more years, a serious added contamination from salt water and oil wastes of the Mid-Continent oil fields.

For the year 1935 the average turbidity of the river water was 980 p.p.m. with a maximum of 15,200 p.p.m. However, turbidities exceeding 50,000 p.p.m. have been noted in previous years. In 1934, a drought year, the chloride content averaged 377 p.p.m. with a maximum of 1,250 p.p.m. There were 139 days in 1934 in which the chloride content exceeded 400 p.p.m., the limit adopted by the company for potability of the domestic supply. In order to reduce chlorides to 400 p.p.m. an auxiliary well supply, located in the river valley near the pumping station, is mixed with the river water prior to treatment and purification. The water from individual wells contains from 300 to 400 p.p.m. of carbonate hardness and from 6 to 19 p.p.m. of iron. When the well supply is used, lime is added to reduce hardness and iron.

Although the present sources have been treated to render a safe water from a hygienic standpoint, the slight saline tastes, odors and tastes from organic sources and the hardness content have been the cause for complaints for years and have kept alive agitation for a better water supply.

FIG. 1—MAKING THE FIRST connection on the 32-inch steel core reinforced concrete pipeline. Each section of the 39-inch pipe is 16 feet long.

The new supply will consist of an impounded lake located on Alum Fork of the Saline River, 32 miles due west of the present filter plant. Analyses of samples from the natural flow of Alum Fork show no appreciable mineral content; the average hardness of the water is 10 p.p.m. The soft water will produce an estimated annual saving of $200,000 in the use of soap, plus additional savings of thousands of dollars in plumbing repairs, fuel and other items of expense chargeable to hard water use.

In planning a new water supply and supply line of this character and magnitude, it is necessary to fix some reasonable future period and estimate the probable requirements at the end of the assumed period. The future period in this case was 40 years or the period fixed for bond maturity.

Many factors must be considered, past rates of growths and local conditions influencing future growths, past rate of water pumpage, per capita consumption and probable increases in per capita consumption or total usage due to probable future industries and uses of water, before an assumption or estimate can be made.

Over the past 13 yr. the daily pumpage from the plant supplying Little Rock and North Little Rock has arranged from 6.07 to 8.36 m.g.d. with maximum days ranging between 8 and 12 m.g.d. The average daily per capita consumption at present is 62 to 65 gal. However, it is believed that with the advent of a soft water supply, due to increased industrial and domestic uses, 80 gal. should be used for future estimates. Thus, in 1975, the average daily use is estimated at 17.5 m.g.d. and the average day for a maximum month will be 24 m.g.d.

The water supply, dependent upon rainfall and runoff, must be ample to supply the estimated annual water consumption for three successive years of minimum rainfall and runoff. The average annual normal rainfall of the 42.5 sq.mi. of drainage area, located in the Ouachita National Forest, is 48 in. A possible minimum year was assumed as 25 in. which is lower than any past record. Allowing for evaporation, transpiration and other losses the runoff for normal and driest years has been estimated as 17.57 and 5.35 in. respectively, or an estimated yield of 14 billion gal. normally and 4 billion in the driest year. The dam will provide a storage of more than 14 billion gal., which will be ample to provide the estimated future requirements even over a period of three or more successive extreme drought years.

The lake to be formed by the dam will be 4 mi. in length, having a surface area of 2 sq.mi. with a shore line of more than 17 mi. The maximum water depth will be 100 ft. at the dam.

A rolled earth dam proved to be the most economical type for construction after comparisons of preliminary designs and estimates on various forms and types of masonry structures.

The dam under construction is 2,800 ft. long including the around-the-end

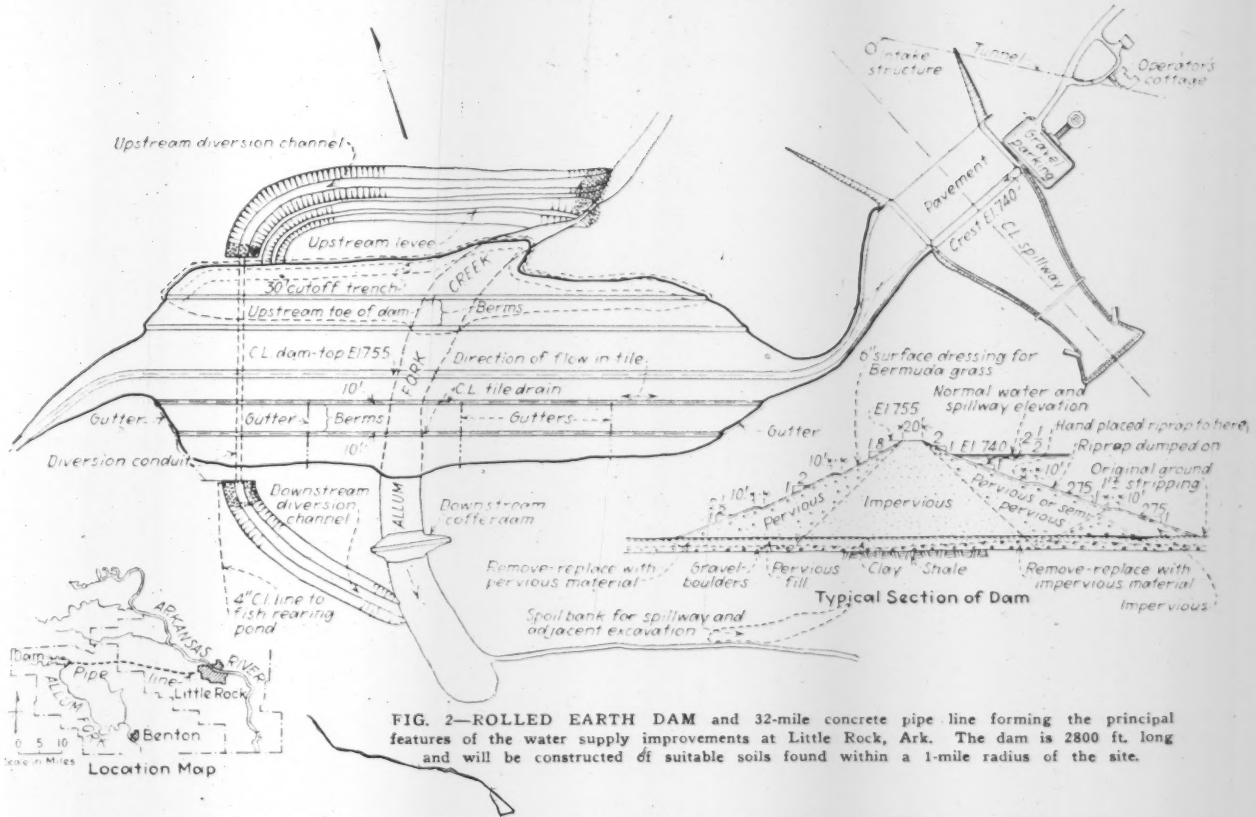


FIG. 2—ROLLED EARTH DAM and 32-mile concrete pipe line forming the principal features of the water supply improvements at Little Rock, Ark. The dam is 2800 ft. long and will be constructed of suitable soils found within a 1-mile radius of the site.

spillway section and dikes. The embankment slope on the water side varies from 2 to 2.75 horizontal to 1 vertical, and on the downstream side from 1.8 to 2.5 horizontal to 1 vertical with 10-ft. berms at every 35-ft. vertical distance from the crest. The crest width is 20 ft. with a maximum bottom width of 550 ft. at the maximum height of 115 ft. above bedrock. The center section with 1 to 1 slopes will be constructed of impervious material, with the downstream section of pervious material, and the upstream section of pervious or semi-pervious material. The total earth yardage as compacted in the dam is estimated at 1,530,000 cu.yd. The water face of the dam will be faced with riprap masonry and the downstream slope will be sodded or sprigged with Bermuda grass, and will be provided with gutters and drains for removing runoff drainage to prevent excessive erosion.

Geological formations at the site of the dam consists of strata of shale and sandstone formations tilted at over 45 deg. with the horizontal and dipping in the upstream direction. Drillings into this formation indicated closely packed solid strata to a considerable depth with no intervening stratum of clay or faults filled with porous or pervious material. Dr. G. Branner, state geologist, approved the site from a geological standpoint as a safe foundation upon which to construct an earthfilled dam. The rock and shale formation, except in the present streambed, is covered with from 1 to 18 ft. of deposit consisting of clay, sand and gravel in varying depths and mixtures. This overburden will be removed beneath the impervious and upstream pervious or semi-pervious sections and the compacted fill placed directly upon the bedrock formation.

Diversion conduit

A concrete diversion conduit of horseshoe shape, 10 ft. in diameter, will be constructed through the west end of the dam for diversion of average normal floods during construction of the dam and upon completion of the dam will be plugged with concrete at the upper end. After the reservoir is filled, this conduit will provide access to a system of pipes that will extend upward into the body of the dam whereby the line and slope of saturation may be observed and determined.

The specifications provide that the earth embankment shall be placed in layers of not to exceed 8 in. in thickness, shall be of a proper moisture content and shall be rolled with at least eight trips of a sheepsfoot roller weighing not less than 1,100 lb. per lin.ft. of tread. Compaction will be tested with a plasticity needle in conformance with the "Proctor Methods" (see articles by R. R. Proctor, *ENR*, Aug. 31 and Sept. 7, 21, 28, 1933). At various depths the compaction shall require a needle reading of from 400 to 2,300 lb. per sq.in. and a dry weight of compacted material of from 110 to 124 lb. per cu. foot.

To locate sufficient material of the proper character to place in the pervious section of the dam, 989 test pits were dug. Laboratory tests were made to determine the stability and imperviousness under varying degrees of compaction and the proper moisture content under which each class of soil would be placed in embankment. Twenty-five different soils were so tested. The test results indicated that soil existing in borrowpits weighing 90 to 95 lb. per cu.ft. dry weight will be placed and compacted in the dam at weights from 110 to 120 lb. per cu.ft. Also the tests indicated that the deepest soil existing at the damsite would settle about 2 ft. if the weight of the dam were loaded upon it, hence all soil will be removed to bedrock and placed under the specified rolling and compaction tests.

Spillway features

The topography at the east end of the dam was well adapted for an around-the-end spillway. A natural saddle existed between two small tributaries to Alum Fork, one above and one below the dam structure.

The weir section of the spillway is 300 ft. wide at an elevation 15 ft. below the dam crest. The approach is fan shape tapering toward the weir. The wasteway decreases in section away from the weir as the velocities increase due to the increasing gradient as required by topographical conditions. The discharge into the spillway canyon or ravine is at a point where the topography forms a stilling basin. The spillway canyon discharges into Alum Fork over 500 ft.

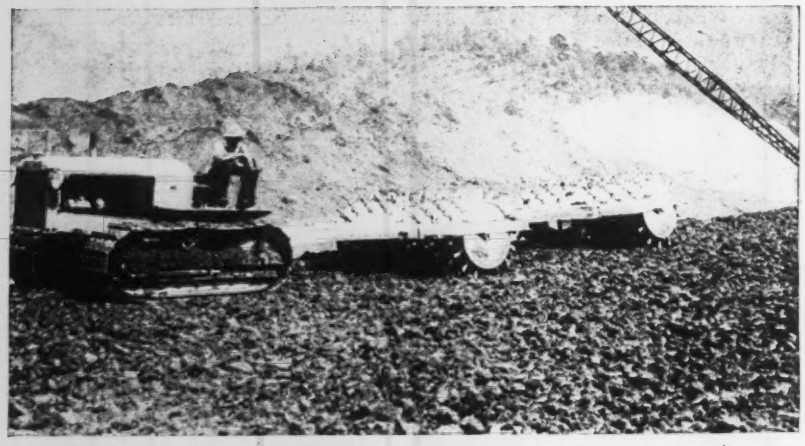


FIG. 3—SHEEPSFOOT ROLLERS in tandem are used for compacting the impervious section of the dam. Earth is spread in 8-in. layers and then packed with 8 to 12 passes of the rollers.

below the downstream toe of the dam with a natural rock bluff deflecting any current tending to erode toward the damsite. The spillway excavation is carried into solid rock and shale formation and the spillway will be lined and paved with concrete.

Careful studies were made as to required capacity for the spillway. The worst possible runoff or flood condition was assumed and careful estimates were made as to storage effects of the lake during such heavy runoff periods.

A spillway capacity of 30,000 sec.-ft. was adopted. The hydraulics of flow at various rates of discharge were carefully calculated and after the design had been tentatively decided, a model spillway at 1/100 scale was constructed in the hydraulic laboratory at Iowa State College. Included with the model were devices to simulate the approach conditions and topography of the stilling basin and canyon through which the water will return to Alum Fork. The model was tested at varying rates of discharge and all hydraulic features such as wave action, hydraulic jumps, velocities, depths, action in stilling basin and outlet canyon, were carefully noted. The curvature of the side walls below the weir required some minor correction which reduced the effect of cross wave action; in all other respects, however, the model demonstrated the correctness of the computations and design. In addition it was also shown that the spillway would carry a discharge of 40,000 sec.-ft. without endangering the main dam structure.

Concrete pipe supply line

A 39-in. internal diameter steel core reinforced concrete pipe-line is being constructed from the present filter plant to the lake, a distance of 167,000 ft. including two reinforced concrete-lined tunnel sections of 1,100 and 1,500 ft. in length. There is a fall of 230 ft. from full lake elevation to water elevation in the first settling basin at the plant. Although the line will be a gravity flow-line the pressure heads will vary from practically nothing to 300 ft., due to the mountainous character of the country through which the line passes. The line is designed for an additional 50-ft. head at the dam end in order that, at some future time when additional capacity may be required, a booster pump may be used at the dam to increase the hydraulic gradient and thereby increase the capacity of the line by 15 per cent. The line is well provided with air-relief valves and combination air-relief and vacuum valves at high points, some 176 valves in all. There are 58 blowoff connections and 81 manholes for construction and inspection purposes.

In most cases where the pipeline crosses small streams or gulleys the trench will be excavated in the solid shale or rock formation, usually exposed in the beds of the streams, and the pipe will be protected by a concrete encasement filling the rock trench and covering the pipe. Only in a few cases will the pipe be carried across ravines on short reinforced concrete bridge structures.

The upper end of the supply line connects with a control gate tower located in the lake toward the east end of the dam. The usual provision has been made for drawing water at various depths by the spacing of the sluice gates. A venturi meter and a cone valve will be installed in the line near the dam outlet for measuring and controlling the required amount of water to be delivered through the line to the purification plant and city system. A venturi meter will also be installed in the line near the outlet to the settling basins. An overflow pressure break is provided between the meter and the cone valve in the lower end of the line and the valves controlling the flow into the settling basins, to prevent any possibility of subjecting the 32 mi. of pipeline to heads above the designed hydraulic gradient heads or against water hammer through closing of the outlet valves. No other valves are to be installed between the upper [illegible] valve and the regulating valves below the pressure break. To have designed the line for the static head from the lake water level would have increased the cost of the pipe line by from $175,000 to $200,000.

Bids were received on the pipeline contract on June 16. Three types of pipe—cast iron, steel and reinforced concrete—were bid upon by eight contracting firms. The award was made to the low bidder, Lock Joint Pipe Co., Ampere, N. J., for a total sum of $1,562,682.72. The pipe is being made in a plant located in an outlying district of Little Rock. The first pipe was laid on Oct. 2. The plant is now manufacturing forty pipe per day, each 16 ft. long, and expects to increase daily production to at least fifty units.

Cost and contract data

Five bids on road relocation were received on Aug 27 and contract was awarded to M. E. Gillioz, Monett, Mo., low bidder, for $39,869.59. Nine bids were received on the dam, spillway and appurtenances contract on Aug. 28, and the award was made to L. O. Brayton & Co., Dyersburg, Tenn., the low bidder, at $921,726.05. Construction camps are being erected for the latter two projects and active construction work was started early in October.

It is estimated that the total completed cost of the water supply project, including lands, rights-of-way, construction work now awarded and to be awarded, interest on bonds during construction, legal and engineering costs and general administration costs will approximate $3,100,000. The project should be completed and the new supply available early in 1938.

Burns & McDonnell Engineering Co. is the designing and supervising agency. Louis C. Hill, consulting engineer, of Los Angeles, was retained by the city at the request of Alexander Allaire, state PWA director, to review the project before awarding final contracts.

City Manager System 28 Years Old

CITY MANAGERS commemorated the the 28th anniversary of the inauguration of the manager plan of government, first adopted by Staunton, Virginia, in 1908, at a meeting in Williamsburg, Va., on October 20. Virginia has the distinction of containing both the first city and the first county which adopted the council-manager system which in three decades has grown to include 445 municipalities in the United States. Arlington County, Va., put a manager in charge of its affairs in 1930, the first of six counties in the country to be governed by the system.

N. Y. CURRENT NOTES ON SEWAGE DISPOSAL

An analytical summary of recent developments for the engineer, research worker and plant operator

WILLEM RUDOLFS,
Chief, N. J. Sewage Experiment Station, New Brunswick, N. J.

● CHLORINATION OF SEWAGE IN TIDAL WATER

Chlorination of sewage for the prevention of odors, to keep sewage fresh, or to retard septic action in an effluent until it has been thoroughly mixed with a large volume of water containing the necessary oxygen for stabilization, has been practiced both here and abroad. In this country such practice has been found effective in relieving the pollutional load on rivers in several cases. In places where obstructions like dams hold back the sewage, or where sewage is discharged into a tidal river so that it is carried back and forth for days in the neighborhood of the outlets, the effect of chlorine treatment has not been evaluated.

It is of immediate interest, therefore, to have a report by Thomas (*The Surveyor*, June 12, 1936) indicating that during a part of the year when the dilution in the tidal river Avon is insufficient, resulting in considerable nuisance from sewage discharges and exposure of mud flats, chlorination was quite effective. Continuous chlorination on a basis of 25 per cent of the chlorine demand effectually checked the sewage from turning septic, and reduced odors emanating from the river. Of particular interest is the fact that the mud flats of the river, generally strongly septic during the summer, became nonseptic after chlorination and remained so during hot weather. These results are attributed to the practice of continuous chlorination instead of chlorination only when conditions are bad.

● IMPROVED BAR SCREEN

Operators of small sewage treatment plants are often troubled by the common type of bar screen used. While the primary object of the bar screen is the protection of pumps, by removing sticks, wire, old shoes and the like, they also catch rags and fibrous matter causing backing up of sewage and loss of head. When the screen is cleaned with rakes portions of these obstructing materials pass through the bars and they either cause valve trouble in pumps or float on the surface of settling tanks. Gail (*Sewage Works Journal* 8, 329, 1936) describes the construction and performance of a screen consisting of 12 gauge galvanized zig-zag plates standing vertically and constricted at the downstream end. Sticks and other large pieces of bulky material are strained out of the flow. Cleaning required was much less frequent than with the former 1½ inch bar screen and there is less loss of head.

● TEXTILE WASTE TREATMENT SURVEYED

Textile waste treatment is an important problem in certain sections of the counry, especially where streams receiving this waste are relatively small. Although a good deal of experimentation has been conducted, resulting in a wide variety of suggested processes, there are wide differences of opinion as to which methods are most satisfactory for treating the various textile wastes.

In order to correlate present knowledge concerning the treatment and disposal of waste waters produced in the textile industries, the *Textile Foundation*, Washington, D. C. (1936) has published a survey which brings together practically all that is known in the field. Emphasis is placed upon certain general points as follows: (1) since waste from various mills differs in character, before a treatment process can be recommended experimentation at each mill is required; (2) chemical precipitation methods have been found to provide satisfactory and usually sufficient treatment for wastes which are not exceptionally high in organic content, but a process combining chemical precipitation followed by mechanical filtration or biological purification is generally required for wastes containing large amounts of organic matter, and (3) the cost of treating a waste by chemical precipitation averages between 10 and 20c per 1000 gal.

The stand is taken that the best method of disposing of textile wastes is to discharge them into the domestic sewers (with some preliminary treatment if necessary). While this is in accord with generally accepted views it must also be recognized that the presence of textile waste materially increases the cost of municipal sewage treatment. The recovery of valuable by-products has been in the minds of many connected with the textile industries but it is pointed out that the possibilities for realizing a profit from such recovery are practically nil; in some instances however recovery or re-use offers a means of reducing the overall expense of disposal.

● TRICKLING FILTERS AS COLLOIDERS

The effects of greatly increased filter rates upon removal of finely divided materials and stabilization of effluents have been so pronounced that a broader conception of the purification mechanism involved in the filtration process must soon be developed. Levine *et al* (*Sewage Works Jour.* 8, 701, 1936) studying in experimental units the effect of ceramic filter media consisting of different sizes of rings, in comparison with granite chips and tile blocks found that at a 16 m.g.a.d. rate considerably larger portions of the filter effluents were in settleable form than were obtained with the customary 2 m.g.a.d. rate usually employed for sewage treatment. It is believed that a large part of the B.O.D. reduction by filtration and part sedimentation is due to the colloider action of the filter. This colloider action is more noticeable at higher than at lower rates. The transformation of colloidal and other sewage constituents into readily settleable material that is flushed out from the filter is marked. This would probably be intensified when a part of the effluent is returned to the filter before settling.

● TWO-STAGE SETTLING TANKS

Experiments carried out at Nuneaton, England, with horizontal flow sedimentation tanks have led to the construction of two-stage settling tanks, each 120 ft. long, 40 ft. wide and 7 ft. deep. The tanks are divided into primary and secondary units by a standing baffle wall situated at a third of the length, thus making the latter twice the length of the former. The sewage enters the primary tanks where sedimentation of the heavy suspended solids takes place. Before it goes over the effluent weirs into the secondary section the pre-settled sewage passes under a hanging baffle running parallel to and situated 3 ft. from the primary tank wall. Another baffle, serving as a scum board, is provided in the secondary unit. According to Moon and Rose (*The Surveyor*, Sept. 18, 1936) the tanks are more effective in suspended solids removal, produce a denser sludge and cost less than two separate tanks.

CURRENT-HIGHWAY PROBLEMS—VIII

Taxes and Transfer of Control

Taxes should be based on appraisal of benefits and present illogical division of highways into systems should be changed.

By T. R. Agg
Dean of Engineering, Iowa State College, Ames, Iowa

FEW PROBLEMS OF *the modern highway are the subject of such jumbled opinion as is that of taxation. It is quite commonly accepted that the financial support of the main road systems (state and federal-aid) should rest in road-users imposts (gasoline tax and vehicle license fees) but when the consideration comes to secondary and township roads opinion shows little uniformity except in truculence. Calm thought and unbiased testimony are so rare among active workers in roadbuilding that the editors have gone to the student for appraisal of modern road tax systems, their trends and the changes in administrative control that they may portend. As a practicing highway engineer, a teacher of highway engineering and a writer on highway finance, administration and engineering, the author of the following article has been for a score of years a serious student of road transport economics. His thinking is well worth attention by all roadbuilding interests*—Editor.

IN DISCUSSING the trend of highway taxation and the extent to which user taxes of various types have supplanted the property tax in the highway program, one is confronted by a lack of authentic and complete data as to the sources of current highway revenues. The data included in Table I have been obtained from various sources, principally, however, from publications of the Bureau of Public Roads. These data are not complete, but they are relatively so and afford a very illuminating picture of what has transpired in the highway taxation field. Without placing too much importance upon the magnitude of the various sums in the tabulation one can see at a glance that for a number of years the trend has been away from property taxes for support of the state highway programs. On the other hand the property tax has been the principal dependence for support of road improvement on the secondary roads, and there was a continual increase in such taxes until the depression years.

The extent of allocation of the proceeds of user taxes to secondary roads is also indicated, and the trend is unmistakable. This trend is still further emphasized by the data in Table II, which may not be complete but are sufficiently comprehensive to bring out a phase of the diversion of road-user taxes that has not heretofore been apparent. A study of Table II shows that in 1935 about a quarter of a billion dollars of road-user tax money was allotted to county and township road funds, but that for only one-third of this money was there any state control that would insure the application of the funds to highway purposes. This control did not always operate to insure the wise and efficient use of the funds, but at least they were actually used for the purpose for which they were intended. About one-twelfth of these allotments were under partial control of the state and probably were actually spent in most part for road work. The startling fact is that 136 million dollars of user-tax money was allotted to counties, townships, and cities without any provision for state control or scrutiny of the expenditure of these funds. There is a strong probability that many millions of this allotment were diverted to non-highway purposes.

The information in Table I may be supplemented by the known fact that in the municipalities the improvement of streets has been carried out very largely with funds obtained from special assessments against the adjacent and abutting property, while the maintenance program has been financed primarily through general property taxes. A user tax (wheel tax) has been employed in a few cities to secure funds for street maintenance.

The general pattern of highway taxation is self evident; the state-highway program is financed through user taxes and federal-aid funds, and the improvement of municipal highways and of secondary roads is financed largely through property taxes. In recent years a modification of this method of financing has developed in those states where a portion of the revenue obtained from road-user taxes has been allocated to the improvement of secondary roads. The amount of such assistance in the United States as a whole has been relatively small, although in some states quite substantial sums have been allocated in this way. The present status of highway finance is well understood among highway officials and public administrators. There is some question as to the extent to which the tax-paying public is cognizant of the situation.

The present systems of highway finance are an outgrowth of pressure for the construction of a network of all-weather roads on the main arteries of traffic. Those responsible for the state-highway programs have wisely taken advantage of the opportunity to finance their construction through an impost which would fall almost exclusively upon those who were most desirous of securing the conveniences afforded by the improvements for which the taxes were levied. In the distribution of the funds so obtained, policies have not always been developed on the basis of a sound analysis of the needs of the traffic. On the contrary, the allocation of funds has often been a matter of political expedience. That a reasonably good job has been done by administrators is evidenced by the fact that those who pay the taxes seem to have been satisfied with the accomplishments in the way of improvements.

During the past ten years there have been desultory discussions of highway taxation and of the correct basis for the levying of such taxes, but it cannot be said that there has as yet evolved any generally accepted statement of the principles upon which highway taxation should rest. The most nearly authoritative statement was probably that promulgated by the Association of State Highway Officials some fifteen years ago, which still constitutes the most widely accepted statement of policy with reference to the subject.

Theory of benefits holds

There appear to be certain considerations that afford a reasonable background for a rational basis for highway taxation, and any political unit may establish its financial policies and levy road taxes in general conformity with these principles and be assured that it is on solid ground. At the root of the right

TABLE I — SOURCES OF STATE AND LOCAL HIGHWAY REVENUE

Ye	Current state highway revenue: Total state and local highway revenue	Federal aid	Total	Sources: Property taxes	Appropriation	Other revenue	Motor vehicle license fees	Gas tax	Current local highway revenue: Total	Sources: Property taxes	Appropriation	Other revenue	Motor vehicle license fees	Gas tax
	$1000	$1000	$1000	$1000	$1000	$1000	$1000	$1000	$1000	$1000	$1000	$1000	$1000	$1000
1904	75,966	250[1]	2,635	2,635	.....	.....	.....	.....	73,081	53,263	.....	19,818	.....	.....
1921	711,329	77,561	182,953	67,227	.....	11,238	101,110	3,378	450,815	379,093	.....	55,011	16,405	306
1922	Not available													
1924	818,673	91,401	274,345	38,367	.....	13,350	174,817	47,811	452,927	383,281	.....	26,569	25,941	17,136
1926	1,076,272	79,163	420,225	48,147	.....	13,223	224,552	134,303	576,884	443,047	.....	56,243	37,861	39,733
1928	1,295,241	80,798	560,335	11,956	42,468	12,612	259,135	234,164	654,108	498,762	.....	51,134	50,433	53,779
1930	1,543,769	92,463	761,313	11,182	32,136	17,084	289,802	411,109	689,993	398,438	96,195	33,338	54,911	107,111
1932	Not available													
1934	994,606[2]	351,061	603,850	21,637		11,742	197,548	372,923						

[1] Federal road construction in Yellowstone National Park.
[2] Includes balance from previous year and transfers of local funds.

TABLE II. EXTENT OF CONTROL BY THE STATE OVER ALLOTMENTS OF USER-TAX FUNDS TO LOCAL GOVERNMENTAL UNITS

	Sums allotted in 1934: To Counties $1000	To Townships $1000	To Cities $1000	Total $1000	Sums allotted in 1935: To Counties $1000	To Townships $1000	To Cities $1000	Total $1000
No control over allotment	106,275	9,189	19,394	134,858	113,834	9,938	12,808	136,580
Partial control of allotment	9,589	51	3,602	13,242	10,175	51	10,114	20,340
Full control of allotment	51,521	9,685	19,035	80,241	56,529	9,206	21,279	87,014
Total	167,385	18,925	42,031	228,341	180,538	19,195	44,201	243,934

States with no control over allotments to counties, 20; to townships, 5; to cities, 6.
States with partial control over allotments to counties, 2; to townships, 1; to cities, 2.
States with full control over allotments to counties, 13; townships, 4; cities, 7.
States making no allotments to counties, 7; to townships, 32; to cities, 27.
(Four states make no allotments to any subordinate unit.)

of the government to tax lies the assumption that benefits flow from the expenditure of the moneys obtained by taxation and expended for governmental functions. Therefore the principle of taxation in accordance with benefits is fundamental. There has also become well established in the theory of taxation the notion that it is perfectly legitimate to graduate taxes in accordance with ability to pay. It will be apparent that the theory of benefits affords a good deal of assistance in determining the proper basis for raising highway revenue.

Access benefits

The purpose of laying out roads and streets in the beginning was to afford access to property in order that it might be utilized for residential purposes or for agricultural or industrial occupation. There can be no doubt that, when highways were provided to afford access to property, the expenditure did confer a benefit on the property. Therefore one of the primary and important benefits from road improvement was that of access to property; what is pertinent today is that road improvements that make access to property more convenient and economical do confer additional benefits. The fact that such a benefit accrues has been the basis of the special assessment system employed for financing municipal street improvements from the very beginning of the program of paving streets. Likewise there is an access benefit to rural land on account of the proximity of highways, and a portion of the cost of the improvement of these highways can legitimately be assessed against the land in the form of a property tax. Such a charge must not exceed the real benefit, which may be much less than the expenditure in many cases. Here the question is not as to the fairness of such an impost but one of the extent of the benefit and the amount that it is fair to assess in exchange for the benefit that accrues. Quite obviously the access benefit afforded to farm lands by highly improved trunk line highways is not sufficiently great to warrant requiring that property as a whole to pay more than a small part of the cost of such improvements. Nevertheless, access benefit would justify the imposition of a property tax to be used for trunk line highway improvement. As we pass from the primary trunk line systems to those roads that are of a secondary or purely local character the improvements are obviously intended almost wholly to afford land access. Such roads are not employed for through traffic, and, since they serve an isolated and rather clearly delineated local area, the lands that receive benefits because of the improvements can generally be segregated and taxed in accordance with the benefits.

There are no comprehensive published data on the relation between various degrees of road betterment and farm-land values, consequently there is no real basis for appraising land-access benefits. This type of research ought to be carried out in several states. (The author has examined the data obtained on two incomplete projects of this type which seemed to be very illuminating. The projects were never completed because of the high cost of the field work.)

It has long been recognized that special benefits to traffic flow from highway improvements. A little consideration of the conditions under which a trip of a thousand miles would be made by automobile in 1920 in comparison with the same trip in 1936, would convince one of the tremendous benefits that have grown out of the long program of highway betterment; this is of course particularly marked on those routes that are employed for long-distance travel. It has been equally beneficial on those routes that are employed for relatively short trips. Not only is the actual cost of vehicle operation much less now than in 1920, due in part to the improvement in the vehicles and in part to the improvement in the highway, but also there is a very material time saving which in many cases has a distinct money value. The benefit from road improvement is not only direct in these respects, but is also real, although indirect, in that it has made possible valuable commercial and social programs that would have been wholly impossible in 1920. By whatever criteria these benefits are measured they amount to tremendous sums of money each year and it is logical and fair that the vehicle should be the basis for the assessment of a tax to pay for the improvements which bring about these benefits. There still remains of course the troublesome problem of distributing the benefits and assessing the tax to the various classes and weights of vehicles in an equitable manner. This question should be given intensive study immediately.

Community benefits

It is considered that certain general community and national benefits also flow from the expenditures for highway improvement. These can scarcely be designated as benefits to the vehicle or benefits to the land. They are reflected in the commercial opportunities that have opened up through the use of the motor vehicle, the new social outlook that grows out of convenient intercourse among communities, and the better conditions of living, working, and playing that are the results of highway improvement and the use of the motor vehicle. Persons who do not use a motor vehicle, for example, benefit through the opportunity to secure supplies of fresh fruits and vegetables made available by motor transportation, and many similar examples might be cited to indicate the existence of these general benefits. The

contribution of all-weather highways to the facility with which national defense may be perfected is not to be overlooked. All of these things constitute a reasonable basis for a contribution by the nation as a whole on account of the benefit road improvement confers on the national life. Such funds must be obtained from imposts that are more than state-wide, because these benefits do not know state boundaries. The principle of federal aid for highways could be amply supported upon the basis of these general benefits if there were no other justification for such a program.

The various classes of benefits that have been discussed are reflected in the general plan of highway taxation that has grown up. Inequities in the application of these principles still exist, and these should be studied with a view to modifications that will make the system of taxation more equitable among classes of people, classes of traffic and areas benefited. The application of a motor-vehicle or gasoline tax to revenues for general purposes or to special non-highway purposes is the rankest kind of imposition upon a class of citizens who have already cheerfully accepted special taxes as a means to good roads. The data in Table II show that in addition to the authorized diversions of user-tax funds which have been protested so vigorously there has crept into our system of financing an insidious form of diversion that is very difficult to trace under our present laws.

Application difficult

The application of the foregoing principles to the actual levying of road taxes involves many difficulties. For example, there are certain streets in the cities in which the traffic is of such a character that access to the property is a minor part of the benefit. When these arterial ways carry traffic that originates almost wholly within the municipality, the financing program should be developed on the basis of a comparatively small assessment against the abutting property and the balance of the cost to be paid from taxes assessed generally over the properties in the city. Sometimes the benefits that accrue from such improvements are clearly confined to a segregated area contiguous to the improvements, and the cost may in such cases be assessed on the district basis. Great care must be taken, however, in such instances to avoid inequities. There will usually be zones along such arterial highways that are not suitable for business purposes and are not desirable as residential properties. These do not benefit particularly from such improvements. Arterial ways that are links in state routes, especially those in the smaller municipalities, often carry a considerable volume of through traffic and there should be provisions whereby a part of the cost of construction and maintenance on these can be met from the funds that are employed for trunk highway construction outside the municipality.

State trunk line highways and the federal highways do afford land access to properties adjacent to them. Such properties under the system of taxation employed in most states do not pay a land-access benefit type of tax. Logically they should do so, but to provide the machinery for the assessment of such a benefit tax and to collect it would probably cost more than the revenue thus obtained would warrant. Such highways are paid for in part from user taxes to which the owners of these lands contribute, but it would be entirely logical for the state to appropriate from its general tax funds a certain sum to supplement the other funds of the state highway department to compensate for land-access benefits and general benefits that accrue from the construction of the state highway system.

The most troublesome problem encountered in the whole field of highway administration is probably that of financing the construction of the secondary and local roads, which are primarily land-access types of roads, but which in many instances carry traffic from considerable areas. It is logical to apply to such roads an appropriate part of the receipts of user taxes because a certain percentage of all of the traffic in the state is on such roads. In the main, however, these roads must be improved from property taxes levied on the basis of land-access benefits. Table I shows that such a policy has been generally followed in the United States.

Shift of control indicated

A consideration of all of the factors involved in levying taxes for highway improvement makes clear the impossibility of achieving anything like equity under the system of divided administration existing in the United States today. There is no geographical correlation between the area under the jurisdiction of the various governmental units and the land-benefit districts and user-benefit zones involved in highway improvement. An increasing drift toward state control of all highways in the state is apparent and seems destined to proceed at an accelerated pace because of a realization of the tax problem.

The first small beginning of the movement toward state control over road work appears to have been the establishment of a state road commission in New Jersey in 1891. The most recent manifestations of this movement were the elimination of the township road authorities in a number of states within the past five years and the consolidation of all road work in North Carolina in the state highway department in 1931.

It is an axiom of public administration that control over funds confers control over the use of those funds. The state highway departments have for a long time aided the local road [illegible] funds and have exercised [illegible] control over the expenditure [illegible] funds. But, due to lack of spe[illegible] statutory authority, the state hig[illegible] departments have allotted fund[illegible] cases where they had no contro[illegible] expenditures, as shown by [illegible] With the frequent changes in [illegible] sonnel of the local highway [illegible] has been impossible to achieve [illegible] approaching efficient manageme[illegible] local funds except in isolated c[illegible]

It seems inevitable that al[illegible] highway work in the states w[illegible] ually be transferred to the state [illegible] departments. This is in keeping [illegible] nature of the administrative [illegible] and will be a wise and economic[illegible] provided there is at the same time [illegible] stabilizing of the state highway [illegible] ments so that long-time planning, clearly defined policies and an efficient, contented and experienced personnel become the goal of those who administer the state highway departments.

The operation of the highway systems of the states is becoming an exceedingly important function of government. Operation involves such things as maintenance, including reconstruction, snow removal, lighting, traffic regulation and policing. Certain of these are the responsibility of the highway departments, and the cost must be provided for. A general survey of the needs in the way of funds for operation activities will often reveal a very much higher expenditure for these items than has heretofore been realized.

Before a system of management for a state can be set up with any assurance, it is necessary for the highway department to have an adequate plan for the highway activities for a period of years in the future, certainly not less than 10 years and preferably 20 years. This means a program of proposed new construction, reconstruction, and maintenance, with estimates of the annual cost of each so that the annual demand for funds for highway improvement and operation can be estimated for several years in the future. Such a plan cannot be perfected until there has been an adequate state-wide traffic survey to determine the traffic conditions on the various parts of the road network, including the secondary and local roads. Surveys of this type are now under way in many states and the preliminary reports indicate that the needs are so clearly revealed by these surveys that it will be possible to group the roads of a state into logical divisions and to provide a system of control that will assure adequate service to the traffic without materially over-improving or under-improving any part of the road system. In other words it is feasible to manage the whole road system on a state-wide basis much more positively and scientifically than has been possible under divided control.

No mention has as yet been made herein of the very great importance of the correlating activities and wise leadership of the U. S. Bureau of Public Roads. It has rendered invaluable service and will continue to be a powerful factor in the highway program if its personnel continues to avoid the pitfalls that bestrew the path of any governmental agency. It must realize, as apparently it now does, that its usefulness will continue only if it exercises wisely its bureaucratic authority and does not become entangled in red-tape and the temptation to promulgate the voluminous, arbitrary and inflexible regulations that have hampered the usefulness of so many governmental bureaus.

Conclusions summarized

(1) There is some indication that the state highway departments have had too great a share of the road money and that the local units have had too little to insure a balanced program of road improvement. In some instances extravagance has developed in the administration of the state highway departments, and overhead costs have been unduly high. On the other hand there is evidence that the local funds have been poorly managed and the local traffic has been inadequately provided for, has been relegated in fact to the role of the poor relation in the program of highway improvement.

(2) Expenditures for highway construction and reconstruction and for the operation of highway systems must continue on a tremendous scale. It becomes increasingly important that the cost of all highway improvements be allocated according to some systematic appraisal of the benefits, and that the property taxes and the user taxes be assessed after a careful study of the benefits accruing to traffic and to property. The present division of the highways of the states into systems is illogical and is a bar to economical management of funds and direction of road improvements.

(3) User taxes are an equitable means of securing funds for highway improvement. Continued research should be carried out to determine how the user taxes should be assessed against the various classes of vehicles.

(4) State-wide traffic and road-condition surveys are necessary to permit developing a program of highway improvement which will be adequate to take care of all classes of traffic and all areas in a state.

(5) A comprehensive study of land-access benefits from road improvements should develop data that would be tremendously useful in financing local-road programs.

(6) The operation of highway systems is growing in complexity and in cost. A careful survey of the needs for the future in the way of operation costs is desirable in order to include all factors that have a bearing on the future highway-financing program.

(7) The trend toward consolidation of administration in the state highway department is in the direction of efficiency and economy, provided the laws relating to the state highway departments are revised and expanded to insure continuity of operating personnel and administrative policies. Moreover, the laws relating to allotment of funds to the local units of government should provide adequate control by the state of the expenditure of these funds.

Old Steel Truss Bridge Moved to Serve Detour

Transfer of old bridge permits maintaining traffic over Barge Canal at Rochester, N. Y., while new bridge is constructed on old bridge site

By Bernard F. Perry
Junior Civil Engineer, New York State Division of Highways, Rochester, N. Y.

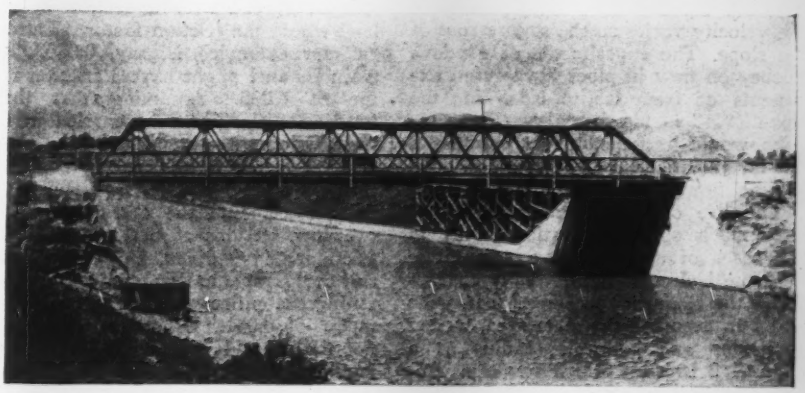
IN ORDER TO MAINTAIN traffic with the least possible inconvenience to the public during the construction of a new bridge over the New York State Barge Canal on highway route 31 leading into the city of Rochester, N. Y., the old 110 ft. steel span weighing 100 tons that was to be replaced was moved 83 ft. to a new location to serve as a detour. Previously constructed trestle approaches and a bypass road permitted traffic to flow over the old bridge in its new location one week after the main road was temporarily closed.

The first operation in moving the old bridge and the one requiring the longest time was the removal of the old concrete backwalls with jackhammers. This was followed by jacking up each end of the bridge about 2 ft., so that a runner beam could be inserted under each shoe. This runner, made up of two 12x12-in. timbers 8 ft. long bolted together and a ⅜x12-in. steel plate fastened to its under side, served to spread the load of one corner of the bridge, some 25 tons, over twelve 5-in. dia. steel rollers.

In order to prevent distortion in the structure, the two corners at one end of the bridge were jacked up simultaneously using two 30-ton jacks at each corner. Since the jacks had a rise of only 9 in., it was necessary to keep blocking the bridge while the jacks were being changed. When the required height was reached, two 10-in. 30-lb. I-beams, 4 ft. long, were set at each end of and at right angles to the end floorbeam of the bridge, to support the structure. By blocking up each end of the short I-beams while the jacks were still in place, and then, after removing the jacks, allowing these beams to carry the load, it was possible to pass the runners underneath to their final positions under the shoes. The shoes were then about 1½ in. above the runners, and it was necessary to lower the bridge down this amount. The runners being in place, it was impossible to place the jacks in a convenient position but, by burning the bottom flanges and tension webs with a torch, the needle beams were slowly weakened and, as they deflected, allowed the shoes to come to rest on the runners. The broken beams were then removed. After the other end of the bridge was mounted in the same manner, the structure was ready for its journey to its new location.

The runway over which the bridge was moved consisted of two 12x12-in. timbers resting side by side and drift bolted to the top of nine timber bents

FIG. 1—OLD BRIDGE ready for moving to the detour location at the end of the falsework shown on the far canal bank



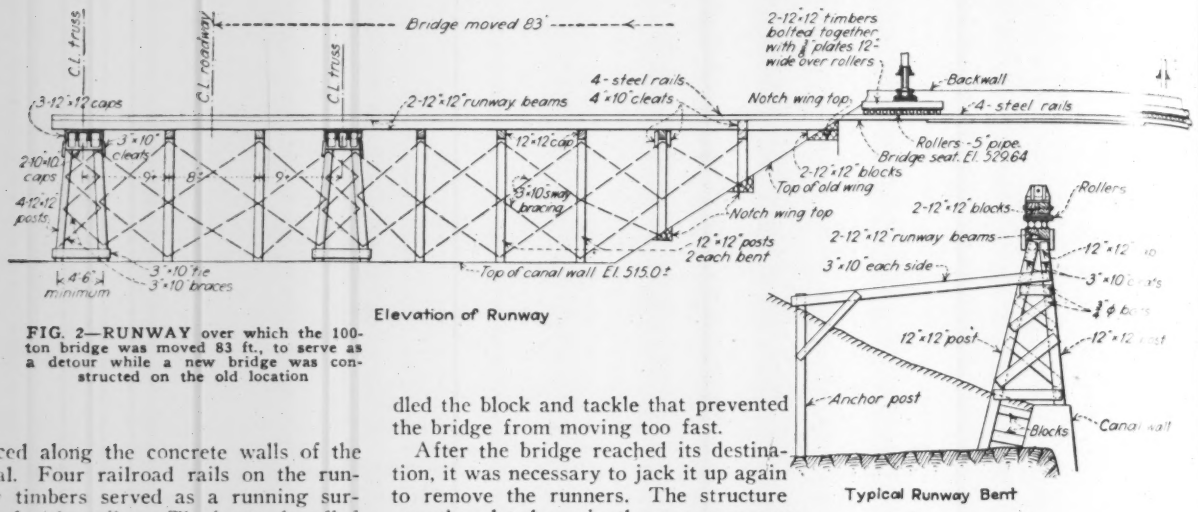


FIG. 2—RUNWAY over which the 100-ton bridge was moved 83 ft., to serve as a detour while a new bridge was constructed on the old location

spaced along the concrete walls of the canal. Four railroad rails on the runway timbers served as a running surface for the rollers. The bents, dowelled into rock behind the walls, were built up of 12x12-in. posts and caps and cross-braced with 3x10-in. planks. The runway structure was also braced longitudinally with 3x10-in. planks.

The actual moving of the bridge was accomplished during a period of 8 hr. by means of a set of 2-ton chain falls at each end of the bridge. Four men operated the falls, four men changed the rollers as necessary and two men handled the block and tackle that prevented the bridge from moving too fast.

After the bridge reached its destination, it was necessary to jack it up again to remove the runners. The structure was then let down in the same manner as it had been raised. The shoes were bolted to the temporary bridge seats and the bridge opened to traffic. Five of the runway bents remained in use as temporary abutments for the detour bridge and as part of the detour approach trestle while the remaining four were removed to permit construction of the new bridge. The railroad rails on the runway beams were also allowed to remain in place under the bridge shoes to spread the concentrated load from the structure over the temporary bents.

The Dolomite Products Co., Rochester, N. Y., was the contractor for the work. For the New York state division of highways, H. E. Smith is engineer of the district in which the work was done and J. P. Larsen is supervising construction engineer. The writer was in charge of the project.

Letters to the Editor

Better Flow Formulas

Sir—The generally unsatisfactory form of present day open channel formulas is well known to hydraulic engineers. For many years, we have accepted the Chezy formula, in some of its variously modified forms, for lack of a better method. Now, with the establishment of the National Hydraulic Laboratory, the time seems ripe for a critical examination of formulas for flow in open channels. Part of this work can be done only in a well equipped laboratory, part must be done in the field. For example, the majority of formulas for open channel flow are based on the assumption that the velocity varies as the square root of the slope. The experiments of Fred C. Scobey on flow in pipes have given exponents of from 0.5 to 0.555 for the slope ("H" in his formula). These results would lead one to suspect that a similar variation might be found in open channel flow.

The use of the hydraulic radius is very much open to question. Only in the cases of a circle or a semi-circle does the hydraulic radius really characterize the channel. A channel 6 ft. wide and 1 ft. deep has the same area, wetted perimeter and hydraulic radius as a channel 2 ft. wide and 3 ft. deep. According to practically all formulas, the velocity of flow would be the same in the two channels, yet very few hydraulic engineers would agree that such is the case.

For use in flow formulas there is needed some quantity which will really characterize the hydraulic section. It may be that the hydraulic radius is as near an approximation to this expression as can be readily derived, but if such be the case, it should be determined by experiment.

As an example of the unsatisfactory nature of our present formulas, consider the case of a river in flood. The water will be spread over a section of low land where the friction factor (Kutter's "n", for example) is, say, 0.060. The main channel might have a friction factor of 0.035. Assuming that three fourths of the water be carried in the main-channel, the weighted value of the friction factor would be 0.041. If the formula used be valid, one should be able to compute the channel and the overflow sections separately, using the friction factors given, and obtain a result comparable to that obtained by computing the entire section with a friction factor of 0.041. Unfortunately, this is not the case. It will be found that the friction factor for the entire section will be less than for the channel section, a result incompatible with actual conditions. Certainly this will show that the commonly used formulas are basically incorrect.

It is not the intention of the writer to suggest a new formula. Rather, he would suggest the means by which a rational formula, amply supported by experiment, might be obtained. Given a formula in correct form, the field work of obtaining coefficients could be carried on with assurance. As a means of obtaining a formula the following suggestions are offered in the hope that by these, or other valid methods, a correct and workable formula may be developed.

A tilting flume should be installed in some large hydraulic laboratory. In this the slope may be changed, while by varying the quantity the cross-sectional area may be kept constant. Tests of this kind will prove whether the velocity varies as the square root, or as some other function of the slope. By varying the cross-section, even to using compound sections simulating a river channel with its flood plain, this function could be well established.

The effect of the slope being determined, attention could be turned to the form of the channel, and to the development of some expression that would characterize the cross-section and its hydraulic properties. By using identical

materials for the construction of the channels, the friction factor could be kept constant for a series of experiments. These studies should permit the development of a formula in correct form, a form in which it could be taken to the field for further study with the assurance that the friction factor would be a true expression of the retarding influence of the channel, instead of being, as it is sometimes aptly named, a "coefficient of ignorance."

It may be that one or more of our present formulas is as near an approach to a correct formula as can readily be obtained. If such is the case, this fact should be thoroughly established by experiment. This research should be made with an open mind, and with the purpose of developing and providing the best possible formula.

This letter is written in the hope that discussions may be started looking to real development in flow formulas.

GEORGE G. COMMONS,
Office Engineer,
Texas State Board of Water Engineers.

Austin, Tex.
Nov. 6, 1936

Training Engineering Craftsmen

Sir—Your editorial of Oct. 15, 1936, p. 557, gives a brief but clear resume of ECPD's present status together with a justified prophetic glimpse into the future. Your comments relating to fear that its efforts in accrediting engineering curricula might lead to an unfortunate degree of standardization are particularly pertinent.

While it is obvious that there must be some means of judging the capabilities of colleges to provide young men with a fundamental education, which together with suitable practical experience will enable them to become professional engineers, ECPD has adhered to the policy that it will not set up arbitrary standards but, as you so well point out, will go only so far as to determine whether a college course under all the conditions surrounding it will pass reasonable *minimum* requirements. Thus is the college left entirely free to develop its methods and accomplishments, provided only that it rises up to and remains at or above this line of demarcation. There can be little doubt that the test will be made more exacting from time to time in the future.

If, as you suggest is possible, ECPD's system of accrediting shall "open the road to the development of engineering craftsmen" the movement will have served a worth-while purpose. It appears that most colleges are determined to provide an education aimed to equip men for a strictly professional career, thus leaving a wide gap between the trade school and the engineering college. Why is it that so little educational effort is devoted to equipping engineering craftsmen, for whom there is and probably always will be a far greater demand than for the strictly professional engineers? Of the latter, there indeed may be an over-supply if current college competition for students is not curbed intentionally or otherwise.

HARRISON P. EDDY
Consulting Engineer

Boston, Mass.
Oct. 26, 1936

Error—Typhoid Map

Sir: My attention has been called to the fact that the map in my article on the "Decline of Typhoid" indicates that Massachusetts and Rhode Island have no cities of 100,000 or more. This is regretted. Table I, however, properly lists nine such cities in Massachusetts and one in Rhode Island: four distinguished as having had no typhoid deaths in 1935 and six as having had rates of 1 or less per 100,000.

N. M. BAKER

Upper Montclair, N. J.
Oct. 1, 1936

North Platte Surge Tank

Sir—In the article on the North Platte surge tank (ENR, Oct. 22, 1936, p. 582) the statement is made that the tank was designed and built by the Chicago Bridge & Iron Works. As a matter of fact the basic structural and architectural design was prepared in the office of the Platte Valley Irrigation and Power District, under the supervision of Parsons, Klapp, Brinckerhoff & Douglas. The hydraulic design was prepared by Chester W. Larner, consulting engineer. The Chicago Bridge & Iron Works revised the structural design and fabricated and erected the tank.

H. A. FOSTER,
Parsons, Klapp, Brinckerhoff & Douglas
Consulting Engineers.

New York, N. Y.
Oct. 26, 1936

Transportation in China

Sir—The article by Arthur M. Shaw in *Engineering News-Record* of June 25, p. 909, gives an erroneous impression of the Yangstze River and its present day transportation facilities above Hankow.

Mr. Shaw states, "From Hankow to Ichang (80 miles) special boats are required on account of the treacherous channels and many rapids." The distance between Hankow and Ichang by river is approximately 350 miles and there are no rapids. The river, between the points mentioned, meanders slowly through a low lying plane that is flanked on both sides by low hills in the distance. It is true that channels have to be followed but it cannot be said that they are treacherous. Previous to this year boats did not travel during the night because the course was not marked clearly. A month ago the difficulty was removed when the bureau in charge of the river signals announced that proper signals had been installed making night travel feasible.

Mr. Shaw continues, "Above Ichang, practically all navigation of the Yangtse is by junk, long lines of 'pullers' being required for the upstream trip." The fact is that the junk cargo boats, plying between Ichang and Chungking, (approximately 450 miles) have almost disappeared from the river. Steam and motor powered vessels now carry the bulk of the traffic and freight. In this section there are many rapids and night travel is impossible. Chungking is the head of navigation for the larger vessels 1,300 tons gross and less. Above Chungking smaller powered vessels go as far as Suifu which is in the neighborhood of 180 miles further upstream.

Sailings are frequent between Ichang and Chungking and one may travel via British, Chinese, French, or Japanese vessels. Off the Chungking foreshore there are anchored the year round, gunboats belonging to Britain, Japan, America, France and China.

Concerning highways in China the writer is not familiar with the work being carried on outside of the provinces of Yunan, Kweichow, Shikang, and Szechwan. In these latter areas great strides have been made during the past two years. At the close of this year Chengtu, the capital of Szechwan, will be connected to Kweiyang, Yunanfu, Sianfu, Changsha and Wanhsien. Also, the highway from Chengtu to Tatsienlu in Shikang is now under construction and it should be completed in the spring of 1937.

Chengtu is in daily communication with Shanghai by aeroplane. Regular air services are maintained between Chengtu, Kweiyang, Yunanfu, Chungking and Sianfu.

A. T. CAIRNCROSS.
Technical Staff of the Generalissimo,
Highway Department, Chungking

Chungking, Szechwan, China
Sept. 4, 1936

Sir: I am most grateful to Mr. Cairncross for calling attention to an error made in my article on "Transportation Trends in China." On looking back through my notes, I find that the original draft showed that I had stated that it was 800 miles from Hankow to *Chungking* but in making a typed copy from long-hand notes, a cipher and one entire line of the text was dropped, resulting in a glaring misstatement of facts. As first written, the statement read that above Chungking "practically all navigation of the Yangtse is by junk." It is the sort of error that one likes to blame the printer for but, unfortunately all the evidence points to the contrary.

ARTHUR M. SHAW.

New Orleans, La.
Oct. 19, 1936

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EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, N. A. Bowers, W. G. Bowman, W. W. DeBerard, C. S. Hill, H. W. Richardson, E. J. Cleary

Editorial Offices at 330 West 42d Street, New York

November 19, 1936

Gas Tax Reform

CURRENT NEWS of motor-vehicle tax affairs offer unusual interest to the road builder. The complacent attitude of the last few years that diversion and other misuses of gas tax and license-fee money were not particularly the road user's problem has given way to an increasingly truculent spirit of resistance by road users. Maine users, although diversion in that state is a threat rather than an actuality, have denied diversion by an overwhelming majority vote. In Massachusetts a change of the constitution to prevent diversion is being demanded by popular petition. Other states are taking up the fight against diversion almost as actively. To say that diversion is doomed is premature; the alien administrative bodies that benefited last year by $140,000,000 of road tax money will not loosen their grip readily. But it is just as certain that our whole loosely built-up structure of road users' taxes is destined for change. Diversion is not the only vicious growth that is being attacked; abuse of refunds, bootlegging, federal imposts, and local surtaxes that in places have put a tax charge of eight to nine cents a gallon on gasoline for motor vehicles are being actively protested. Road users' taxation has been abused and reform is being justly demanded. If road interests are to preserve their greatest source of income for developing road transport they have a vital task in directing reform into constructive action.

Poor Witnesses

MOST ENGINEERS are at their worst as witnesses in court proceedings. Nervousness, or lack of knowledge of what is expected, or failure to appreciate when precision of statement ceases to be a virtue, often causes them to impress the jury unfavorably. Similarly, when appearing before regulatory commissions many engineers are unable to bring out convincingly the facts and figures needed to support their side of the argument. Some of the reasons why this is the case are set forth by Martin T. Bennett in this issue with special reference to regulatory commission work. What Mr. Bennett says of the pitfalls that lie in the path of the expert witness before a commission and of ways for avoiding them apply equally well to proceedings in a court of law. They should, therefore, be studied by all engineers, for none may be sure that they will not at some time be called to appear on the witness stand. One point not specially emphasized by Mr. Bennett has been a source of confusion to engineers in many lawsuits: the danger of attempted exactness, especially with respect to unimportant details. Engineering is an exact science and engineers should be exact on all important details. But carelessness in giving exact figures, especially unimportant ones, frequently affords the cross-examining lawyer an opportunity to make the witness ridiculous. On the other hand, the engineer must not be too indefinite about important details because again a skillful lawyer may be able to discredit his whole testimony by making it appear that he lacks knowledge. As Mr. Bennett points out, the safest course for an engineer is to plan his testimony carefully before he goes on the stand.

Truck Roads

ONE ELEMENT of the San Francisco-Oakland Bridge which received scant attention in the fanfare of the opening ceremonies is the separate roadway for trucks and buses. Although the truck deck will not carry traffic for another year, its significance is obvious even now. If memory serves, this is the first exclusive truck highway in this country; previous recognition of the truck as a serious problem has taken the form of ruling it off certain roads. Parkways immediately come to mind as one example. The Pulaski Skyway, New Jersey's 3-mile elevated road west of the Holland Tunnel, is not available to commercial traffic. In the several vehicular tunnels throughout the country trucks and buses must stay in a designated "slow lane". And on a good many bridges and on main highways, the outside lanes are known as truck lanes, although little effort is made to enforce this use. It would be inaccurate to contend that the truck problem has been ignored by students of highway planning. On the contrary, the truck or bus, as a central figure in hundreds of tragic accidents and as a factor in cutting down highway capacity and in wearing out pavements before their time, is never left out of a discussion of the future of our highways. It is only that heretofore the trend has been to provide special roads exclusively for passenger cars, so that they could avoid the commercial vehicles. Provision of a special truck roadway on the Bay Bridge by no means reverses this trend, but it does afford the most direct recognition yet given to the truck and bus problem. Probably there are few highway routes in the country that could economically justify a separate roadway for commercial vehicles. But if and when such an artery is built, the Bay Bridge will afford the precedent.

Bought and Paid For

TWO OTHER ITEMS in connection with the Bay Bridge deserve emphasis before the engineering world turns away to unfinished business. Both refer to safety: One concerns the safety of construction workmen, the other the safety of those who use the bridge. For the latter a result of high excellence was achieved. On the finished bridge all of the usual traffic-control and heavy-railing safeguards are supplemented by the best night lighting that science can now supply; the sodium vapor lamp installation on the bridge is the most notable in the country, and, like the truck roadway, may be a symbol of safer days to come. But safety for the motorist is little compensation for the families of the 24 workmen who lost their lives during the building of the bridge. Considering the actual money spent so far, there was one life lost for each two million dollars expended. Here is mirrored a situation that commands the attention of everyone in any way connected with construction. Every usual safety precaution was taken by the several contractors, yet death continued to follow the construction dollar. Were these men sacrifices to construction speed? Did their deaths result from unavoidable dangers of a difficult job? Were they victims of their own carelessness or of a code of construction safety that is outmoded and ready for the scrap heap? Construction men might address these questions to themselves, for the Bay Bridge record was not gossly exceptional. The bridge user's con-

venience and safety are often bought and paid for by sacrifice to lessened safety in construction.

Irrigation Losses Continue

SOME FACTS BROUGHT TO LIGHT during the recent election campaign show that the long history of money losses in irrigation development has not yet ended. Oregon has suffered a loss of $4,000,000 of state funds as a result of its law guaranteeing the interest of irrigation district bonds for a period of years, Governor Martin declared. Much larger additional sums were lost by people who bought such irrigation district bonds; through default of the districts and subsequent refinancing, the bondholders often lost three-fourths of their investment. Such facts not only show that the underlying problems of land development remain unsolved, but they indicate quite as clearly that the public benefits arising from irrigation development have never been realistically appraised. Whenever a new irrigation development is undertaken, the state in which it is located welcomes it as a great public improvement, an asset to the state. If the development is truly a public asset, and if it is a fact that the state as a whole has benefited by the development, then the state can well afford to contribute to its costs, and by the same token Oregon might well enter the $4,000,000 bond interest expenditure under some other heading than "Losses". But also, when the true situation is recognized a state would probably proceed by different methods from those of the past. It would set up a plan under which its contribution to the irrigation project would not go to enrich land speculators and would not serve as a lure by which innocent investors would later be defrauded.

The Prime Question

FORECASTS of the probable attitude of the coming Congress suggest that public housing construction is likely to be continued. The bare possibility that this may come to pass is a challenge to the claims of those who say that private enterprise can provide all the housing that the nation needs. The public housing movement as it has developed during the last half-dozen years was in effect an indictment of private housing. If the indictment no longer holds, therefore, the prime question is whether private housing is prepared to recognize its responsibility.

No one can seriously question that the principal house-building is fundamentally a private function. Unless we are willing to degrade part of the working population to the rank of wards of the state, it is the business of each one to provide his own housing just as he provides himself with clothing and food. Public housing is tolerable only when private industry and business consistently fail to provide habitable housing for all.

They have so failed in the past. It is useless to repeat the fact that reckless promotion, poor planning and shoddy construction have too largely marked the work of the private housing interests and that local authorities have failed to establish or to enforce safeguards. Sensational illustration of the latter fact may be found in the quarter-century survival of long outlawed tenements in New York. The shortcomings of private housing enterprise are revealed in the high cost of housing and the reiterated insistence of mortgage and renting interests that obsolete buildings of slum type are the only housing available for the low-income groups. It is not the only housing available if private industry would forget the absurd precedent set by the present luxurious public housing and produce a house that the low-income worker can pay for.

Three things are needed to provide adequate housing for all: sound financing, good planning and good building, supplemented of course by proper public supervision. Let sound financing be provided and a major element of excessive cost will disappear. Let proper development planning be done, with house design, quality and price protected by public certification, and there need be no more palaver about the necessity of maintaining slums in order to provide shelter for the workers of lowest income capacity. With these elements assured there need no longer be doubt that private housing can meet all the requirements of furnishing adequate and suitable shelter.

The issue is whether private housing interests—finance, promotion, planning and construction—are ready to eliminate exploitation, incompetence and negligence from their work. If so, the housing problem can be quickly solved. If not, we may expect public housing to continue; in fact public housing will then become an assured and permanent development.

Practical Welfare Pioneering

NEW YORK is only one of the seventeen states that have an occupational disease compensation act, but it is blazing the trail for sane and equitable administration of the act and for practical measures to control silicosis, most serious of all occupational diseases. The New York law has two outstanding features: provision for a medical board, and the requirement that all drilling work in siliceous rock be done with approved methods of apparatus for the control of rock dust. The first feature is found in only two other states; the last is exclusive with New York.

Although the act as amended last spring became effective in June, the state industrial commission has proceeded cautiously to work out effective and equitable means of administration. Silicosis is regarded as the biggest problem, and the commission has concentrated on this disease. The preparatory step was to start a survey of the state's industries to determine the prevalence and hazard of silicosis.

Rock drilling and excavation was tackled first as an administrative problem, and the compilation of a code of rules and regulations for this work was regarded as of primary importance. A committee of medical men, representatives of labor, contracting, insurance and mining, as well as rock-drill manufacturers and makers of dust-control equipment was organized to advise on the code, and the result, which represents a compromise of conflicting opinions, is now ready for public hearing.

To determine the effectiveness of dust-control methods and apparatus, the state is conducting a series of tests of drill dust-control equipment, carried out with remarkable thoroughness, and intends that only equipment meeting strict requirements set up in the test procedure shall be approved for use. Dust created by underground blasting and mucking will next be considered. Through a program of this kind New York is progressively working its way through the complex problem of industrial dust control. Other states may profit by watching the outcome of the state's pioneering efforts.

CURRENT NEWS

PWA Makes Grant For Municipal Power

Two and a half million allotted to High Point, N. C., for generating plant on the Yadkin River

The Public Works Administration announced on Nov. 14 a grant of $2,595,000 to the city of High Point, N. C., for the construction of a publicly owned hydro-electric generating plant and dam on the Yadkin River near Winston-Salem. This will supply energy for the municipally owned distribution system, which now purchases current from a subsidiary of the Duke Power Co. A suit brought by the Duke Power Co. challenging the constitutionality of PWA grants to municipalities for public power systems is now pending before the U. S. Supreme Court.

Due to the special nature of the franchise of the private power company at High Point, the PWA does not anticipate that the city's right to build this project will be subjected to litigation. High Point, a city of about 38,000 population, now owns and operates the electric distribution system, purchasing energy from the private power company. The franchise of the power company specifically states that the company shall not sell electric light or electric current in opposition to the city of High Point. The city in turn agrees not to serve any motor of more than 5 hp.

The rivers and harbors act of 1927 provided for a general survey by the Corps of Engineers of certain rivers in the United States. The Yadkin-Pee Dee in North and South Carolina, was one of these rivers, and was surveyed and reported upon in 1931 by the U. S. District Engineer of Charleston, S. C. This survey included a study of the Styers project on the Yadkin River near Winston-Salem, and this project is to be built in accordance with the plans of the United States engineers with certain modifications. The total length of the river is 435 miles, of which the upper 202 miles (above the mouth of the Uwaharie River) is called the Yadkin. Below this it is called the Pee Dee.

The project consists of an earth dam with a maximum height of 84 ft. and provided with a 500-ft. spillway having a capacity of 157,000 sec.-ft. The power station is located on the north bank at the dam and consists of a concrete structure 200 x 45 x 50 ft., housing six direct-connected vertical hydro-electric units, the wheels having a capacity of 5,570 hp. each, at 68 ft. head, and the generators having a rated capacity of 4,150 kw. at 200 r.p.m. The plant substation, with a capacity of 24,500 kw., is located on the north bank also.

Water is to be drawn from the reservoir through three intake towers, each serving two generating units through 12-ft. penstocks 650 ft. long. The average head available for power purposes is 63 ft. If the plant is operated independently without flood control, utilizing only the storage of 235,540 acre-ft. available in the uppermost 20-ft. of the project reservoir, the primary or continuous regulated flow amounts to about 1,500 sec.-ft.

Studies made by the city show that a reservoir operated for prime power will be sufficient flood control, even if no special part of the reservoir capacity is allocated for that purpose. Records of stream flow over a 40-year period show that efficient operation for the greatest amount of prime power will require that the reservoir be drawn down throughout the late spring and summer months and that there will be a large capacity available for flood control during the fall.

Two short sections of highway No. 60 will be flooded, requiring the rebuilding and extending of the Mountain Highway bridge over the Yadkin River, the construction of two new highway bridges, and of 2.52 miles of concrete paved highway.

U. S. Engineers Approve Florida Canal

A canal providing a minimum depth of 33 ft. and a minimum width of 250 ft. across Florida is justified in public interest, according to a revisory report made by the special board of officers of the U. S. Engineers which was appointed to restudy the Florida canal. Col. Earl I. Brown is chairman of the special board.

The board estimates that such a canal will cost $157,585,000, exclusive of land, in addition to the $5,400,000 already expended.

The new report will be the basis of a public hearing held Dec. 16 before the board of engineers for rivers and harbors in Washington. Although copies of the report are withheld from publication, they may be consulted at the offices of the Corps of Engineers in Washington, Jacksonville, Ocala, and Richmond.

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Bids Called in Buffalo For New Sewage Plant

The Buffalo, N. Y. Sewer Authority on Nov. 2 passed a resolution authorizing advertisement for bids for construction of an estimated $1,934,000 worth of buildings and equipment for the $3,800,000 sewage treatment works on Bird Island. The bids will be opened Dec. 8 and contracts will be awarded, it is expected, a few days later. Construction on the sewage plant is expected to start before January.

Bids will be sought on divisions 2, 3, 4, 5, and 6 of the sewage treatment plant. On division 2, for the pump station and grit chamber, the engineer's estimate is $860,000. For division 3, the sedimentation tanks, it is $680,000. Division 4, the sewage pumping equipment, is estimated at $250,000; division 5, electrical work and equipment, at $84,000; and division 6, the sluice gates, at $60,000

To Redesign Two Housing Projects

Bids rejected on two projects and plans changed to lower cost—New bids on Washington project save $135,000

After two different advertisements for the construction of Andrew Jackson Court, the PWA low-rent housing project in Nashville, Tenn., had resulted in bids so high that the resulting rent would have been beyond the reach of the low-income families for which the new community was intended, Public Works Administrator Harold L. Ickes last week ordreed the redesigning of the project plans.

The plans will be so changed as to increase the number of the rooms without materially increasing the building cost, thus considerably reducing the cost per room. A somewhat less expensive type of construction will also be employed. The revised program calls for the addition of a second story on most of the houses; the present foundations, now completed, will be adequate for the larger houses. Thus 122 dwellings will be added to the 276 units in the original plan. Additional economy will be obtained in the heating arrangement of the project. The original plan calls for a large central high-pressure heating plant, supplying heat for the entire development. A change to a different type of group heating will cut this cost by simplifying distribution.

The Housing Division is also considering a plan to divide the project into several contracts, enabling smaller contractors to have an opportunity to present bids for the superstructure.

The revised plans are scheduled for completion by the first of the year.

After the first set of bid received had indicated excessively high costs for Sumner Field homes, the Minneapolis low-rent housing project, Administrator Ickes ordered that this project also should be redesigned and all bids be rejected. It is probable that the time allowed for construction will also be extended.

A saving of $135,000 in the cost of superstructures for Langston, the $1,600,000 housing project in Washington, D. C., was effected by throwing out the first bids on the project. On the second letting the contract was awarded to the Chicago firm of Coath & Goss on their low bid of $1,388,000.

At the time of the first opening, only two firms submitted bids, the lowest of which $1,523,000, exceeded PWA estimates. At that time both bids were rejected and new proposals invited. At the second opening, eight bids were submitted. The Coath & Goss bid proved to be $135,000 less than the rejected low bid of the first opening.

The contract covers completion of the project. Foundations for the development have been completed, and erection of the buildings will get under way as soon as the contracts have been executed. The development will provide 274 low-rent units in two-story flats, group houses, and three-story apartments.

Contractor Held Liable for Injuries on Steamship

The P. J. Carlin Const. Co., of New York, and the Travelers Insurance Co. are liable for injuries sustained by employes of the contractor injured in the explosion of the S. S. "Observation" Sept. 9, 1932, carrying workmen from the mainland to Rikers Island, East River, New York, according to a decision handed down by the U. S. Supreme Court on Nov. 9. The contractor was engaged in construction of Rikers Island penitentiary, and made arrangements with Capt. Forsythe, owner of the "Observation," to conduct the workers to and from the island. The men paid 10c. a round trip, and in the event daily receipts fell below $60, the contractor made up the deficit to the boat owner. On the morning of Sept. 9, 1932, one Edward Heaney and several other workmen were seriously injured when the boiler of the boat blew up.

Compensation was awarded

The New York state industrial board awarded compensation to Heaney, and the contractor and his insurance carrier, the Travelers Insurance Co., appealed the award. The Appellate Division and the state Court of Appeals confirmed the award, as did the U. S. Supreme Court in decision No. 9, October term, 1936. The original award for compensation was based on the contention that Heaney "stepped into his employment the moment he stepped aboard said steamboat." The petitioners protested the award on the grounds that the state industrial board lacked jurisdiction because the accident occurred on navigable waters and the rights and obligations of the parties were fixed by the maritime law. They also maintained that Heaney was not employed when injured.

Supreme Court's opinion

The Supreme Court commented: "This Court has often ruled that the maritime law cannot be enforced by state enactments. . . But this doctrine, we think, has no application in the circumstances here presented. The present attempt is to enforce a liability assumed by employer and insurance carrier under a non-maritime contract. All parties, as well as the accident, were within the limits of New York state. The contract had no direct relation to navigation. . . There is no claim against the ship or her owner; their rights are not in issue. . . The court below reached the correct conclusion, and its judgment must be affirmed."

CHICAGO OUTER DRIVE LINK TAKES SHAPE

FEATURING a huge double-leaf bascule over the mouth of the Chicago River, a single-leaf bascule over the Ogden Slip (foundations in lower right-hand corner of the view) and 3,600 ft. of steel viaduct, the Chicago outer drive link between the north and south side boulevard systems has reached the stage of superstructure erection.

The Chicago River bascule is 264 ft. long between trunnion bearings and 108 ft. wide, the largest bridge of its type yet built. Rigid two-story bents characterize the viaduct to be built on the south side of the river, provision being made for a lower deck. The north side viaduct, 1,200 ft. long, and completed as far as the north bank of Ogden Slip, is of one-story construction.

In the foreground of the view is the Chicago River bascule with steel erection just completed. Running west from the bridge along the river wall is the viaduct section that will some day be extended on to Michigan Boulevard (the first bridge shown upstream) and connect with Wacker Drive. At present the viaduct turns south at the point where the steel work is shown erected and extends to the retaining wall-abutment structure seen under construction at the left side of the picture. To the south, beyond this abutment, is a fill a block long which connects with the existing Outer Drive at Monroe St. The steel viaduct erected west of the abutment is the Randolph St. extension, also a part of this interesting project.

With Fort Peck Dam Half Done; Dredging Stops for Winter

Hydraulic fill operations at Fort Peck dam on the Missouri River in Montana closed down for the winter season on Nov. 1 as severe freezing weather sent the four large dredges into the protection of the winter harbor. Temperatures near zero for three consecutive nights froze the core pool in the dam, necessitating the seasonal shutdown. The dam now contains 50,000,000 cu. yd. of hydraulic fill, just half of the total requirement. Over 28,000,000 cu. yd. was placed during the 1936 season of 28 weeks since Aug. 16, a filling rate of 1,000,000 cu. yd. weekly. This rate is one third higher than that for which the dredging plant was designed. The progress is all the more remarkable in view of the necessity of pumping the fill for the long dike to the west of the main dam, which kept one dredge busy for more than three months pumping against a static head of 230 ft., the highest on record for hydraulic earth moving.

The four dredges, their accompanying floating booster plants and the floating derricks and tow boats will winter in a slip dredge from the river toward the inlet of the diversion tunnels, which will become the diversion channel with the closure of the dam next summer. For several weeks the dredge *Missouri* has been extending the slip toward the tunnels, wasting the cuttings because they contain too much shale washed down from the nearby bluffs to make suitable material for the dam. This dredge will continue excavation as long as possible in order to complete the diversion channel to the tunnel inlets this winter.

Oregon Planning Board Seeks Geology Department

The Oregon State Planning Board will submit legislation prepared by its advisory committee on geology and mining to the Oregon legislature at its January session looking toward the formation of a state department of geology and mineral industries. According to the proposed act, the department will have a governing board of three, to serve without pay, and a paid director selected by the board. The bill carries the request for an appropriation of $50,000 per year to carry out the work.

Duties of the board would include the conducting of a geological, geographical, and topographical survey of the state. The board would also be required to make qualitative determinations of ores and minerals submitted by the citizens of the state and to conduct surveys of geologic and mineral resources. It would also study scientific and economic questions in the field of geology and mining and serve as a bureau of information on the mineral resources of the state.

California Revokes Licenses Of 29 in Six Years

Announcement of revocation of three certificates this month by the California state board of registration for civil engineers brings revocations for the 6-year period during which the board has been functioning to a total of 29. Under the plan of operation the board uses, it often is sufficient to issue a citation for an offender or to advise him not to apply for renewal of his certificate, which must be done annually to keep it active. Some seven or eight citations are issued for every revocation.

By far the greater number of revocations has been for false statements or misrepresentations in the original application for certificate. When some 6,000 applications were received in the period immediately after the registration law became effective, certificates were issued on the claims made by the applicants, but all were warned that a thorough check of statements would be made. This check ultimately resulted in 25 revocations.

A twenty-sixth revocation resulted when a registrant was convicted of a felony. The twenty-seventh arose from complaints about dishonesty in performing contracts. Although the board has no jurisdiction on that ground, the complaints resulted in a recheck of the application originally made by the registrant, and false statements were found therein. The twenty-eighth offender was shown to have been conducting a business in which he signed and used his seal on building plans, thereby taking responsibility therefor, without actually checking them. The regular fee charged for this service was $5, and the operation of "checking" required only a few moments. The specific case on which the trial was conducted was the checking of a one-story, brick building 25 x 46 ft. in plan. Although a relatively unimportant structure, its inadequate design was held to be a menace to life, and the registrant was found guilty of fraud and deceit in applying for the building permit.

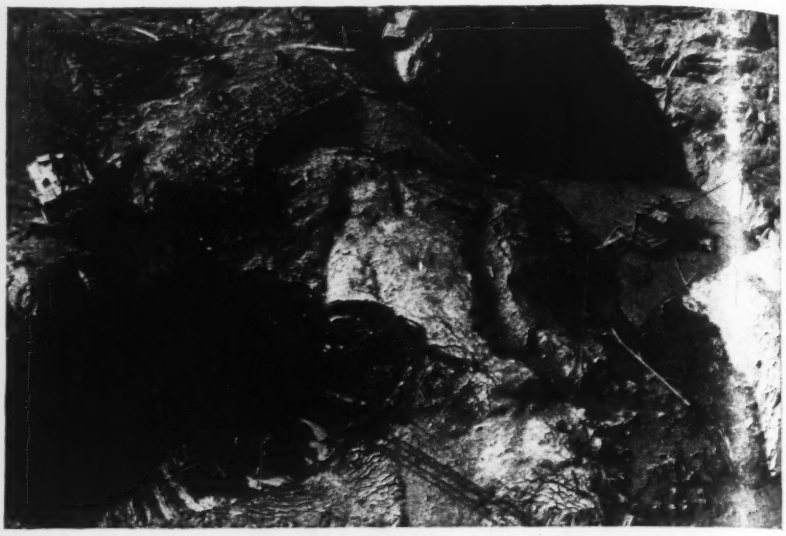
The twenty-ninth certificate was revoked after it was shown that the defendant had accepted $125 (total price to be $150) toward payment for designing and erecting a 50-ft. wooden tower to be used for supporting an electric sign. Such a tower is not permitted by building regulations, and the registrant was found guilty of fraud and breach of contract.

The total number of registered civil engineers in California is 4,427. Hence, 29 revocations represent about two-thirds of one per cent of the number registered.

Montrose Hayes Dies

Montrose W. Hayes, chief meteorologist and head of the river and flood division of the U. S. Weather Bureau at Washington, died in that city on Nov. 16, age 62.

A native of Charleston, S. C., Mr. Hayes started service with the Weather Bureau in 1892. He helped to organize the hurricane service in the West Indies, and gained a national reputation in the forecasting of Mississippi floods while stationed at St. Louis between 1910 and 1929. He was also responsible for organizing the national weather forecasting service of the Argentine Republic.



FROZEN EARTH STOPS SLIDE AT GRAND COULEE

A dam of frozen clay and gravel has been used to stop slides of earth into the east pit at Grand Coulee Dam. The earth refused to stand on a 2 to 1 slope, and efforts to stop the slide by construction of a concrete retaining wall nad by resloping proved ineffectual. The method finally chosen to stop the slide was to sink brine pipes and create a dam of frozen earth at the base of the slide. The dam is a 105-ft. radius arch, about 100 ft. long, 40 ft. deep, and 25 ft. thick, abutting on the granite walls at the edge of the slide.

The dam is frozen moist clay and gravel. About 400 freezing points, in eight rows, are driven to bed rock. The heads of the freezing points may be seen in the upper left-hand side of the picture. Each freezing point consists of a 1½-in. pipe within a 3-in. pipe. The 1½-in. pipe is connected to the brine supply line and discharges at the bottom of the 3-in. pipe, allowing the brine to return to the top of the 3-in. pipe, where it is conducted to the next freezing point through a hose connection. An ammonia refrigeration plant which can produce 100 tons of ice per day will furnish the cold brine to the freezing points.

The project is estimated to cost about $20,000, and, it is believed, will more than pay for its cost by the excavation that will be saved.

Golden Gate Bridge Suit Won by J. B. Strauss

A suit brought by J. B. Strauss against the Golden Gate Bridge and Highway District for additional fees covering design services was tried recently before a jury in San Francisco. The jury brought in a unanimous verdict in favor of Mr. Strauss for $262,500, the full sum claimed. The following essentials of the case are from a statement obtained from the attorneys:

Mr. Strauss took a contract to do all the engineering on the bridge for 4 per cent of an assumed structural cost of $27,000,000, with the understanding that the plans would be prepared progressively during the course of construction. Subsequently the directors of the district ordered all plans to be prepared at one time so that lump sum bids could be called for. By reason of this departure from the agreed procedure, Mr. Strauss claimed he was put to additional expense amounting to $262,500. This sum is 1 per cent of the assumed cost less a credit of $7,500.

The defendant contended that under the laws of California Mr. Strauss was functioning as a statutory public officer and that, as such, extra compensation could not be allowed for duties within the scope of his employment; that the extra work involved was within the scope of his original employment; and, finally, that the board had no authority to grant him extra compensation for work which his contract required him to do.

Plans are said to be under way to apply for a new trial and to take an apepal to the state supreme court.

General Harding Dies

Brig.-Gen. Chester Harding, retired, died at Whitinsville, Mass. on Nov. 11 at the age of 70.

General Harding graduated from the University of Alabama in 1884 and from the U. S. Military Academy in 1889. After a three year period in the graduate school at Willetts Point, N. Y., he took up work in Chicago on river and harbor improvements. In 1894 he was appointed to duty on the Mississippi River, and after two years on that work was made instructor at the Military Academy. He was advanced to the rank of captain in 1898 and to that of major in 1906. In the latter year he was appointed engineer-commissioner of the District of Columbia. In 1914 General Harding was transferred to the Panama Canal as engineer of maintenance in the permanent government of the Canal Zone. In 1917 he became governor of the Panama Canal Zone, succeeding General Goethals. He held this position until his retirement in 1920.

Washington Highlights

By Paul Wooton

The government now has a total of $33,000,000 worth of buildings under construction in the District of Columbia. All are contracted and supervised by the Procurement Division, Treasury Department, except the Federal Reserve building which is being built by that department. Buildings for the Department of Agriculture and the Department of the Interior are costing $12,000,000 each. A $4,000,000 building is being built for the Bureau of Engraving and Printing and a $3,484,000 building for the Federal Reserve. The Government Printing Office gets a $1,042,000 building, and $641,000 is being spent on three buildings for the Zoo.

The four committees appointed last spring by the Secretary of Labor to study silicosis will meet in Washington on Dec. 15 to prepare a program for a general conference on the subject to be called during the first part of January. The purpose of the public meeting in January will be to devise educational methods leading to the reduction of the silicosis hazard.

A report dealing with the role of the urban community in the national economy will be issued early in 1937, the National Resources Committee expects. The subject has been under study for some time by a special committee headed by Clarence A. Dykstra, city manager of Cincinnati, Ohio. The study was initiated at the request of a number of organizations, including the American Municipal Association, the Conference of Mayors, and the Joint National Conference on Planning. The principal objective of the study is to prepare recommendations leading to the improvement of statistical data on social trends in urban development, particularly as collected by various agencies of the federal government. The information now available, the committee has found, is collected infrequently and irregularly and is insufficiently detailed to depict social trends. As a result of its labors, the committee hopes to present an outline of recommended municipal reports which, in the course of time, would build up a statistical base sufficiently detailed to permit definite conclusions on social tendencies resulting from urban life.

Federal Project Contractors Exempted from State Tax

The Oregon Supreme Court has ruled that an out-of-state contractor doing work for the United States government within the state is not subject to state income tax on his profits. The opinion said, "The state has no jurisdiction over land the fee to which has been acquired by the federal government and has no legislative authority to tax any of the operations thereon or any income arising from work done thereon."

The opinion arose from a suit brought by Winston Bros. Co., a Minnesota corporation, and Guy F. Atkinson Co., against the state tax commission and a separate suit by the Atkinson company against the commission.

The plaintiff contractors performed, in 1934, a contract for the War Department for building a dam, locks, and ship canal at Bonneville Dam and reconstructing the south jetty on the Columbia River. When the state sought to impose an income tax on profits of the job, the company sued in Multnomah County. The county court found for the state, but the high court, in the present opinion, reverses that decision.

Unemployment at Nine Million

The total number of unemployed workers in September, 1936 was 8,975,000, according to estimates of the National Industrial Conference Board. This compares with a maximum of 15,939,000 unemployed in March, 1933, and an average total of 1,132,000 unemployed in 1929.

Employment in all types of enterprise in the United States in September 1936 was 43,747,000 workers, an increase of 9,116,000 over the depression low of 34,631,000 employed in March, 1933. The number of employed workers in September was 3,409,000 below the average of 47,156,000 workers employed in 1929.

Re-employment has been greatest in the manufacturing industries, with an advance of 3,033,000 workers since March, 1933. Agriculture re-employed 1,488,000 workers. The construction industry has re-employed 1,358,000; the service industries 1,288,000; and trade, distribution, and finance 1,142,000.

The difference between the increase in employment and the decrease in unemployment is accounted for by the number of young workers coming into the labor market since 1933.

SOCIETY CALENDAR

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, San Francisco, Calif., December 7-10.

AMERICAN ROAD BUILDERS ASSOCIATION, convention and highway exhibit, New Orleans, La., Jan. 11-15.

AMERICAN ENGINEERING COUNCIL, annual assembly, Washington, D. C., Jan. 14-16.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Detroit, Mich., Jan. 27-9.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, annual meeting, New York City, Jan. 21-3.

ASSOCIATION OF WESTERN STATE ENGINEERS, annual meeting, Santa Fe, N. M., Dec. 3-5.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, MIDDLE ATLANTIC SECTION, fall meeting, New York City, Dec. 5.

UNIVERSITY OF COLORADO, highway engineering conference, Boulder, Colo., Jan. 14-15.

LICENSE EXAMINATIONS

IOWA, examination for professional engineering on Dec. 1-2, and for land surveying on Dec. 1-2, and for land surveying on Dec. 3, in the Senate Chamber at the State House, Des Moines, Iowa.

SOUTH CAROLINA, examination for professional engineers and land surveyors on Dec. 1, in Columbia in the office of the Board at 1218 Senate St. Applications must be filed with the Secretary of State Board of Engineering Examiners before Nov. 21.

The following officers were elected at a meeting, held on October 27, of the NORTH CAROLINA SECTION of the AMERICAN WATER WORKS ASSOCIATION: president, H. G. Baity; vice-president, H. E. Thompson; secretary-treasurer, A. R. Hollett; member of the National Board of Directors, Paul Frisk.

No Winter Rise In WPA Load

Washington Correspondence

Employment under the works relief program for the half-month ending Oct. 15, 1936 showed a slight increase over the preceding period, but this was almost entirely due to emergency drought employment, according to figures released by Harry L. Hopkins, Works Progress Administrator. Industrial recovery is being reflected in the relief load, and the usual cold-weather increase is expected to be absorbed almost entirely by private, rather than by relief, employment. The winter's peak is expected to be only slightly greater than the 3,498,000 men employed on WPA during the first half of October.

Mr. Hopkins refuses to predict how long present funds will last, or how much additional appropriation will be necessary to finish out the fiscal year ending next June 30. He indicates that the so-called white collar projects can be expected to constitute a larger part of the relief load, since the skilled or semi-skilled labor is usually the first to regain private employment. Asked if a shortage of skilled labor had become embarrassing to WPA projects, Mr. Hopkins answered that it had been necessary to turn down a number of suggested projects requiring types of labor not listed on the relief rolls, and stated that the program is continually being modified to fit the work to the labor available.

The Administrator also announced that the supervisory staff had been reduced in number by 1,000 persons during the month of October.

Contract for Control Works On Nile Awarded

A contract has been awarded by the Egyptian government to the British firm of MacDonald, Gibbs & Co. for construction of two barrages on the river Nile. Construction will be started on Jan. 1, 1937; the work will cost $11,250,000 and will take four years to complete.

These barrages, each a third of a mile long, will raise the level of the Nile 6½ ft. They will replace two built by the French more than a hundred years ago. By raising the river level, they will aid navigation in the dry season and will serve to distribute the water of the Nile into three main canals, the Behera Canal, which supplies water for irrigation to the western portion of the delta as far as Alexandria; the Menousia Canal, to the central portion; and the Tewfiki Canal, to the eastern portion in the direction of Port Said.

The barrages are located about 20 miles north of Cairo at the point where the Nile splits into the Rosetta and Damieta branches; one barrage will be placed in each branch. Both will be built of Egyptian granite and both will contain locks for the passage of shipping. The Rosetta barrage will have 46 openings and the Damieta barrage 34, each 8 meters in width, closed by heavy steel sluice gates operated by overhead power driven machines. A roadway accommodating two lanes of vehicular traffic will cross each of the barrages, being carried over the navigation locks on swing bridges. Main work construction runs from December to June.

Federal Coordinator Calls Industrial Conference

George L. Berry, Coordinator for Industrial Cooperation, has invited all representatives of industry and labor to meet with the Council for Industrial Progress, which will hold its third session in Washington Dec. 10-11. The main business of the conference will be the formulation of a program of industrial legislation aimed at stabilization of recovery, creation of employment opportunities, and improvement of competitive and labor conditions in industry.

After an open session on the first day, with addresses by leaders of various groups on industry's legislative needs, the second day will be devoted to executive sessions of the council, which will consider progress reports from seven committees which submitted findings last March. These committees dealt with national industrial policies; maximum work week; general wage, and child labor; fair trade practices; internal and external competition; anti-trust laws (including the Federal Trade Commission Act); financial aid to small enterprises; and government competition with private enterprise.

Practically every one of these committees made recommendations which would require legislative or administrative action by the federal government, and it is believed the further action of these committees will deal with plans to effectuate their previous conclusions.

A committee on employment and unemployment data will make its initial report at this session.

N. Y. Professional Engineers Ask Building Law Changes

A further expression of the interest aroused in building law revision by the recent collapse of an apartment house under construction in the borough of the Bronx, New York City, is evidenced in a resolution recently adopted by the New York County chapter of the New York State Society of Professional Engineers.

The resolution states that "a situation exists in the building industry by reason of which the public safety is being jeopardized" and recommends that the building laws be so amended as to require that every application for a building permit be accompanied by plans and specifications signed by a registered architect or licensed professional engineer. It is further recommended that construction be required to be supervised by the same architect or engineer and that before a certificate of occupancy is issued a statement must be signed by the architect or engineer that he has so inspected the construction.

Illinois Engineers Form State Assembly

Professional engineers of Illinois met in Peoria on Nov. 9-10 to organize a state assembly of the Ameriian Association of Engineers. A constitution and by-laws were adopted, and the following men were elected to sreve as the first board of directors: T. B. Johnson, L. R. Bowker, J. B. Sitzler, Harold Austin (all the above men are from Peoria), Homer Hollingshead, Springfield; A. H. Krom, Chicago; R. C. Kellogg, Chicago.

The primary purpose of the assembly, as set forth in the constitution, will be "to coordinate the efforts of the engineers of Illinois in assisting the American Association of Engineers to promote the social and economic welfare of the engineer, to stimulate public service in the profession, to encourage and develop the efficiency of the engineer, and to promote unity in the profession."

Efforts will begin immediately to push enactment of state laws requiring the registration of all professional engineers.

Price-Fixing Combination In Metal Windows Charged

The Federal Trade Commission has issued a complaint against 19 corporations and their trade association, the Metal Window Institute, charging the maintenance of a price fixing combination, the purpose of which is to restrain, monopolize, and eliminate competition in the sale of metal window products. The respondent corporations are said to constitute substantially all of the manufacturers of metal window products in the United States, and to sell a considerable amount of their output to federal, state and municipal governments.

It is charged that the institute and its members engaged in the following practices: They acted through their trade association to set up a basic price book giving a price or formula by which prices may be determined for every product of the industry. They maintained and adhered to a schedule of uniform discounts, the effect of which was to establish fixed, uniform, minimum prices. They fixed uniform terms and conditions that were a part of all sales made. They submitted all bids on projects in a given area to a regional clearing bureau, for the purpose of securing identical estimates which they used in bidding on the projects.

It is further charged that "non-cooperating" competitors were forced into the association by declaring certain jobs on which these competitors bid "open" and underbidding them.

Montreal Considers Revision Of Its Bidding Methods

In an effort to end abuses in contract work carried out for the city, the city council of Montreal has decided to seek power to have its charter amended to change the procedure in receiving bids and awarding contracts. The changes sought follow the recommendations of a special committee recently appointed to study the situation.

Under the proposed revision of practice, bidders will be asked to appear before the executive committee of the council at the time set for receiving bids, present their bids in person, and have them opened at once. The present practice of submitting bids some days before they are to be opened is not rigid enough, it is thought, to prevent tampering with bids after they are received.

It is also proposed to set aside annually a special sum which will enable more time to be spent on designs and specifications than can be spent at present. Inspectors on city work will be appointed by the director of public works and not by aldermen.

A new form of contract is intended to be adopted which will make contractors responsible for difficulties encountered through subterranean conditions. Unit prices for extra work will be set by the city, based on market prices.

Personals

STANLEY H. WRIGHT, whose appointment as acting state director for the PWA in North Carolina was announced recently in these columns, has been appointed state director.

CAPTAIN S. D STURGIS, JR., Corps of Engineers, has been assigned to duty as assistant to the district engineer in Boston, Mass. Captain Sturgis will be stationed at Eastport, Maine.

E. W. HOPKINS, who has been associated for the past 13 years with the Kansas City consulting firm of Black & Veatch, has resigned to accept a position as city engineer of Salina, Kansas.

CALVIN C. OLESON has resigned his position as bridge designer with the Missouri State Highway Department to accept a position as instructor in civil engineering at South Dakota State College.

DR. COMFORT A. ADAMS, formerly dean of the Harvard Engineering School and professor of electrical engineering at Harvard since 1906, has retired from teaching to devote himself to consulting practice in Philadelphia.

WILLIAM E. STANLEY, consulting sanitary and hydraulic engineer, associated for the past 13 years with the Chicago firm of Greeley & Hansen, has been appointed professor of sanitary engineering at Cornell University to fill the vacancy arising from the retirement of Prof. H. N. Ogden.

PAUL V. HODGES, associate engineer of the Office of Indian Affairs of the Department of the Interior, who has been in Coolidge, Ariz., preparing a report on the Gila River for the San Carlos irrigation project, has transferred to Billings, Mont., to do work in connection with the design and construction of dams and reservoirs on Indian reservations in Montana, Wyoming, and South Dakota.

SAMPSON K. BARRETT, professor of electrical engineering at New York University, has been appointed assistant dean of the college of engineering in charge of the evening engineering division. Associate professor LEWIS V. CARPENTER has been promoted to professor of sanitary engineering. DR. LLOYD R. SETTER, formerly a member of the staff of the New Jersey Sewage Experiment Station, has been appointed an instructor in sanitary engineering.

ROMEO VALOIS, director of public works for the Catholic School Commission of Montreal and professor of financial or-

ganization at L'Ecole Polytechnique, Montreal, has been appointed director-general of the committee on planning and research of the Metropolitan Commission of the Island of Montreal. REAL BELANGER, an engineer in the sewage department of the city of Montreal, has been appointed technical assistant to Mr. Valois.

Obituary

PETER H. FRANK, general contractor, and builder of many government and apartment buildings in Buffalo, N. Y., died in that city on Nov. 8.

SEAFORD JACKSON, general manager of the contracting firm of Franklin M. Harris & Co., which constructed many large buildings in Philadelphia, died in Collingswood, N. J., on Nov. 11.

ALEXANDER MCGINNIS, a building contractor of Washington, D. C., and Springfield, Mass., died in Revere, Mass., on Nov. 11 at the age of 61.

WILLIS E. AYRES, consulting engineer of Memphis, Tenn., for many years active in flood control and drainage work, died on Nov. 8 in Memphis. Mr. Ayres built many of the larger drainage systems in Arkansas, Mississippi, and Missouri. He was a graduate of the University of Arkansas.

WILLIAM I. BAUCUS, city engineer of Northampton, Mass., since 1924, died in that city on Nov. 6 at the age of 61. He was formerly city engineer of North Adams, Mass., and had previously been an engineer of the Boston metropolitan district water supply commission.

A. S. HOVEY, 86, a civil engineer of Helena, Mont., died on Nov. 9. Mr. Hovey served as a cadastral engineer for the public land survey for a number of years. He later entered private practice, and was employed for a time as an engineer by the Montana State Highway Commission.

EDWIN E. FLETCHER, retired senior member of the firm of Fletcher-Thompson, Inc., of Bridgeport, Conn., died on Nov. 2 in Bridgeport at the age of 68. Mr. Fletcher was a graduate of the Sheffield Scientific School at Yale University. Before organizing the Fletcher-Thompson company, he was construction engineer for the Bridgeport Brass Co. Mr. Fletcher retired about ten years ago.

CONSTRUCTION STATISTICS FOR THE WEEK

ENGINEERING construction awards total $44,158,000, slightly higher than this year's average week to date. This is made up of private, $15,008,000; public, $29,150,000; federal, $6,207,000; state and municipal, $22,943,000. Corresponding values for last year are: total, $51,646,000; private, $6,334,000; public, $45,312,000; federal, $4,829,000; state and municipal, $40,483,000.

Increases are recorded this week in sewerage, bridges, industrial buildings, public buildings and streets and roads. The classified totals are: industrail buildings, $10,563,000; commercial buildings, $3,890,000; public buildings, $7,970,000; highways, $12,181,000; bridges, $2,376,000; sewerage, $3,268,000; waterworks, $431,000; earthwork, drainage, $1,333,000; unclassified, $2,146,000.

The larger awards for the week include: continuous sheet strip steel mill, Bethlehem Steel Corp., Sparrows Point, Md., $5,000,000; buildings at Dixon State Hospital, Dixon, Ill., $990,000; superstructure, Langston Housing Project, Washington, D. C., $1,389,000; superstructure, Logan Fontenelle Homes, Omaha, Neb., $1,283,000; highways, Indiana, $560,000; Minnesota, $556,000; South Carolina, $645,000; city reconditioning 57 mi. streets, relief labor, Newark, N. J., $6,235,000; sewage disposal plant on North Buffalo Creek, Greensboro, N. C., $674,000; sludge equipment for Southerly Sewage Plant, Contract 92, aeration building, blower building, etc., Contract 93, Cleveland, Ohio, $1,409,000; dredging 2,862,700 cu. yd., Savannah Harbor, Savannah, Ga., est. $500,000.

Additions to new capital include Republic Steel Corporation bonds, $23,300,000; state and municipal bonds, $7,483,000, plus purchase of $2,366,000 in PWA bonds from RFC; and PWA, $2,595,000.

CONTRACTS
(Thousands of Dollars)

	Weekly Average Nov. 1935	Prev. 4 Weeks	Week Nov. 19 1936
Federal Government	$3,797	$3,456	$6,207
State and Municipal	22,871	22,212	22,943
Total public	$32,668	$25,668	$29,150
Total private	6,075	13,435	15,008
Week's total	$38,743	$39,103	$44,158
Cumulative to date:			
1935 $1,312,782,000	1936..$2,070,402,000		

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1936	Week Nov. 19	Cumulative
State and municipal	$9,849†	$444,741
PWA non-federal	229†	151,113
RFC loans		26,663
Corporate issues	23,300	233,438
PWA loans, Private		—1,665*
Total Non-Federal	$33,378	$854,290
Federal		691,237
Federal		
Total new capital	$33,378	$1,545,527
Cumulative to date:		
1935..$2,632,831,000	1936..$1,545,527,000	

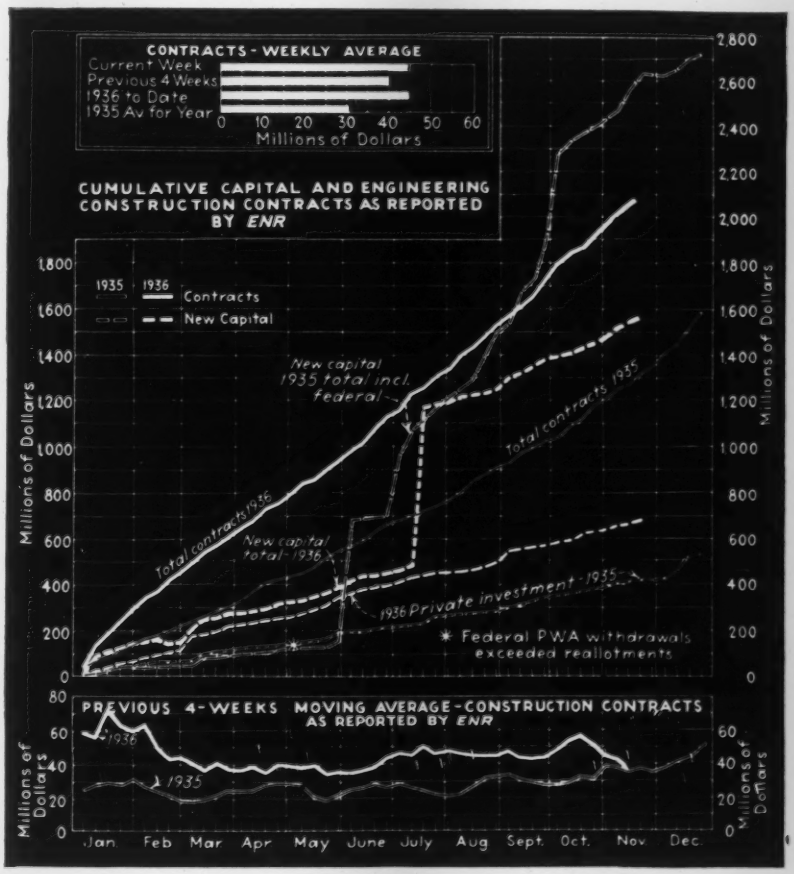
* Bond sales in this classification exceed reallotments during current year.

† Includes transfer from federal to private investment financing through sale by RFC of PWA bonds.

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities. RFC direct purchase of bonds for "self liquidating" projects, and 25 per cent of WPA construction appropriations.

INDEX NUMBER

EN Cost	1913 = 100	1926 = 100	EN Volume	1913 = 100	1926 = 100
Nov., 1936	212.70	102.24	Oct., 1936	178	78
Oct., 1936	211.50	101.67	Sept., 1936	200	88
Nov., 1935	194.90	93.69	Oct., 1935	162	71
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47



Construction Equipment and Materials

Portable Weld Tester

A new hydraulic machine for testing the strength of spot welds has been developed by the Baldwin-Southwark Corp. of Philadelphia for the Edward G. Budd Manufacturing Co.

Portability is the outstanding feature of this new tension testing machine. It is supplied with a round base for rolling from place to place and a hoisting hook for moving with the crane. It has an overall height of 70 in., and 18 in. diameter steel base, a low center of gravity, and weighs about 800 lb.

An 8-in. dial indicates the load. The cylinder is located at the top of the machine and has a 4½-in. diameter ram with a 2-in. stroke. Fluid under pressure is pumped by a gear pump situated in the base of the machine. This pump is direct connected to a ½ hp. motor.

A self-aligning type of file-face grip is used. These grips will accommodate offsets in welded specimens up to ¼ in. without using backing plates or liners, it is said. Specimens up to 1-¼ in. wide can be tested.

All working parts of the machine are said to be easily accessible by removing the front cover plate.

Sewage Screenings Shredder

Sewage screenings from bar racks (hand or mechanically cleaned) are shredded so as to be returned to the Sewage flow by the Triturator recently put on the market by the Chain Belt Co. of Milwaukee. Screenings are reduced to minute pieces by the shearing action of $350,000 blade cuts per minute, leaving no stringy or large pieces of disintegrated material, and are then removed by sedimentation and handled as primary tank sludge. The triturator consists of a toothed rotor revolving between two grates with the cutting teeth intermeshing the grate bars. A feature is the pivoting of the grates under heavy spring pressure, thus providing a suitable yielding of the grates under excessive loading and allowing the passage of tramp material without severe damage to the machine.

Abrasion-Resisting Pump

Greatly reduced internal wear in the pumping of sand-laden water is the outstanding feature of the new Counterflow pump, according to the American Manganese Steel Co., manufacturers of the new pump.

This freedom from internal wear is accomplished, the manufacturer states, by a design which provides clear water, under pressure, between the impeller shrouds and the shell side plates. This counterflow action replaces sand-laden water, which is a cutting compound, with clear water.

The new design is available in all sizes of new Amsco pumps, and most pumps now in service may be converted to take advantage of the counterflow design.

European Cement Admixture

An admixture to be combined with cement in proportions of about 1 per cent of the volume of the cement is being introduced into this country by Charles A. Pfeiffenberger, West Hempstead, N. Y. Known as Mellitol, it was invented by H. Opalsky of Aussig, Czechoslovakia and is said to have been used in Europe to obtain a concrete having a high degree of waterproofness, decreased shrinkage, increased flexural strength, and increased resistance to chemical influences in the atmosphere and in water. It has been added both during the manufacture of the cement and in the field, where it is incorporated in the mortar. Its use is said to permit a reduction in the amount of water required for a given concrete mix. The product, under the name of Mellitol-Cement-Elastic is said to have been used extensively in the construction of the new automobile roads in Germany and for a number of government buildings.

Pneumatic Concrete Placer

Increased output with a reduced consumption of air is claimed by the Ransome Concrete Machinery Co. of Dunellen, N. J. for their new pneumatic concrete placer. These advantages are said to arise from the use of a worm feed conveying the concrete from the charging chamber to the discharging chamber.

Mixed concrete is charged into the charging opening, after which a horizontal sliding door operated by compressed air is forced against a machined seat, sealing the intake opening; an air jet is provided for cleaning this sealing door, keeping it free of concrete. The worm feed in the bottom of the cylindrical receptacle forces the concrete into the discharge chamber, where air is applied which carries the batch of concrete through the pipeline to the point of deposit. The worm is driven by an Ingersoll-Rand type HH air motor through a reduction gearing.

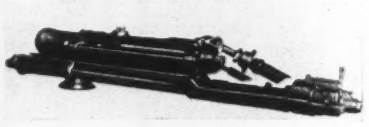
These machines are manufactured in ½ yd., ¾ yd., and 1 cu.yd. capacities.

Automatic Feed For Drifter

The Chicago Pneumatic Tool Co., of New York City, has developed the Speedfeed, an automatic feed to replace the hand feed on CP drifters. The Speedfeed increases the overall length of the drifter, as compared with that equipped with a hand feed, by only a fraction of an inch and increases the weight by only 22 lb.

The automatic feed has two different actions. The primary feed operates to bring the steel up to rock or to back it away from the rock. The drill piston striking into the cushion at either end of the cylinder sets up a rotary motion in the feed screw. The direction of rotation is controlled by a double ratchet and selective pawls which are operated by a small lever. This primary feed will advance or withdraw the machine at will or lock it in any position.

The secondary feed operates when the machine is in drilling position. As soon as the steel reaches rock, the primary feed stops working because the piston strikes the steel instead of striking into the front cushion. The secondary feed catches the impulses of the poston striking into the rear cushion and feeds the drill forward. The action is entirely automatic and is said to maintain the proper striking position regardless of drilling speed.



Manufacturer's Activities

✦ The INTERNATIONAL CEMENT Co. has changed its name to the Lone Star Cement Corp., in order to conform to the name of its principal product.

✦ The INLAND STEEL Co. of Chicago has announced the establishment of a Chicago district sales office; Mr. Leon Reed will be district sales manager.

✦ The DOW CHEMICAL Co. of Midland, Mich., has just opened a Chicago branch office in charge of Wilson I. Dean.

Plant Expansion

✦ GAR WOOD INDUSTRIES, INC., of Highland Park, Mich., are just completing a new building to be devoted to the manufacture of Gar Wood road-building machinery.

✦ The ATLAS POWDER Co. of Wilmington, Del. is beginning construction on the first unit of a plant for the manufacture of industrial chemicals. The expenditure involved is about $1,000,000.

✦ Construction of twelve storage silos, each 80 ft. high and 26 ft. in diameter and with a total capacity of more than half a million sacks of cement, nearly doubling the present storage capacity, will begin shortly at the Independence, Kansas, plant of the UNIVERSAL ATLAS CEMENT Co. Work will also start soon on a new electrically operated-packing and sack handling plant that will increase present facilities by 50 per cent.

✦ CUTLER-HAMMER of Milwaukee, Wis. has just opened a new plant in San Francisco. The new factory will be devoted to the manufacture of switchboards, fuse cabinets, panelboards, transformer cabinets, and wiring troughs.

Personnel Changes

✦ Thomas Cruthers has been appointed vice-president of the WORTHINGTON PUMP & MACHINERY CORP. Mr. Cruthers will be in charge of sales activities with large steam power stations, railroads, waterworks, sewage, drainage and irrigation projects.

✦ The NOVO ENGINE Co. of Lansing, Mich. has appointed R. C. Harvey as sales manager.